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TWO NEW MYRMECOPHILOUS MITES OF THE GENUS ANTENNOPHORUS.[1]

By William Morton Wheeler.

The mites of the genus *Antennophorus*, owing to their extraordinary parasitic relations with various ants of the genus *Lasius*, have been assiduously studied in Europe by Janet, Wasmann, Karawaiew and Berlese, but up to the present time our North American species have remained unknown. A few North and South American mites, to be sure, have been described as species of *Antennophorus*, but they are now known either to belong to different genera or to have a very doubtful taxonomic status. Several years ago I found on some workers of *Lasius umbratus* Nyl. var. *aphidicola* Walsh, at Colebrook, Connecticut, a large, active mite, which Wasmann described as *Antennophorus wheeleri*.[2] Berlese[3] however has recently placed this species in a distinct genus, *Echinomegistus*, which also includes, though in a separate subgenus (*Antennomegistus*), a Brazilian mite which he formerly described as *Antennophorus caputcarabi*. In another paper Wasmann described under the name *A. barbatus*[4] a large mite which was found attached to a common legionary ant, *Eciton praedator*, in the state of Santa Catharina, Brazil, but it is by no means clear from his brief description, in which he dwells only on a few superficial characters, that the specimen is a true *Antennophorus*. Berlese has shown that still another species, *A. raffrayi* Wasmann, found in nests of *Plagiolepis custodiens* at the Cape of Good Hope, belongs to a peculiar genus which he calls *Physalozercon*. I am inclined to believe from the taxonomic changes which have overtaken

[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 12.

[2] Zur Kenntnis der myrmecophilen Antennophorus und anderer auf Ameisen reitender Acarinen. *Zool. Anzeig.*, XXV, 1902, 72.

[3] Illustrazione Iconografica degli Acari Mirmecofili. *Redia*, I, 1904, p. 398.

[4] Neue Dorylinengaste aus dem neotropischen und dem aethiopischen Faunengebiet. *Zool. Jahrb. Abth. f. Syst.* XIV, 1900, p. 41.

all of these species except *barbatus*, and the insufficient evidence of this really being an *Antennophorus*, that the genus will prove to be peculiar to the north temperate zone and to comprise species which are always parasitic on ants of the genus *Lasius*. As this group of ants is abundantly represented in North America, we should expect the parasitic genus to have a like representation. This turns out to be the case, since during the spring of 1909 I succeeded in finding near the Arnold Arboretum at Forest Hills, Boston, Massachusetts, two typical *Antennophori* allied to the four known European species (*uhlmanni* Haller, *foreli* Wasmann, *pubescens* Wasmann and *grandis* Berlese). The American forms occurred, as was to be expected, on workers of the common yellow ants belonging both to the typical genus *Lasius* and to the subgenus *Acanthomyops*, which is peculiar to the nearctic fauna. Only one of the mites, the one I call *A. donisthorpei*, was seen in a living condition. It was perched on the gula, or lower surface of the ant's head, actively waving its long, antenniform forelegs about in the manner so often described for the various European species. There can be little doubt, therefore, that, like its transatlantic cousins, it titillates its host or any ants within reach of its appendages and induces them to feed it with droplets of regurgitated food. Janet[1] has shown that when only a single *A. pubescens* is present on the European *L. mixtus* it clings to the ventral surface of the ant's head, with its forelegs directed towards the ant's mouth-parts. When two are present, there is one on each side of the head or one on each side of the gaster; in the former case the antenniform appendages are directed towards the anterior, in the latter towards the posterior end of the ant's body. When there are three mites, one attaches itself to the gula and the two others to the sides of the gaster. Four place themselves in pairs on the sides of the head and gaster. If six are present, which rarely happens, four are arranged in pairs on the sides of the head and gaster, while of the two remaining individuals, one attaches itself to the gula, the other to the mid-dorsal surface of the gaster. Janet believes that these symmetrical arrangements are for the purpose of balancing the burden and thus making it easier for the ants to carry.

As the species of Lasius on which both the European and North American *Antennophori* occur, are specially devoted to attending root-

[1] Sur le Lasius mixtus, L'Antennophorus uhlmanni, etc. Études sur les Fourmis, les Guêpes et les Abeilles Note 13. Limoges 1897, 62 pp., 16 figs.

aphids and root-coccids and may be said to live in permanent symbiosis with these Homoptera, we can understand why the mites occur only on these particular ants. The plant-lice and mealy-bugs pump the juices out of the plants and pass on to the soliciting ants the unassimilated portions in the form of saccharine excrement, while the ants regurgitate some of the liquid to the mites which ask for it by aping, with their long, hairy, forelegs the antennal movements of hungry ants. In other words the ants serve as cup-bearers, distributing to one another and to the indolent, sedentary *Antennophori* the nectar which the tapster aphids and coccids keep drawing from their vegetable hosts.

Owing to this intimate serial ethological arrangement the worker *Lasii*, unlike most of our ants, do not have to come out on to the surface of the ground to seek their food, but live a hypogaeic, or subterranean life. The eyes of these workers have therefore become so minute that their visual powers must have nearly or quite disappeared. We can, perhaps, best appreciate the relations of these ants to their parasites, if we fancy ourselves blind and condemned to live in dark cellars and continually occupied in pasturing and milking fat, sluggish cows that yielded quantities of strained honey instead of milk. Then let us suppose that occasionally there alighted on our cheeks or backs small creatures which took great care not to annoy us by placing themselves in positions asymmetrical to the median longitudinal axis of our bodies, and stretched forth to us from time to time small, soft hands like those of our children, begging for a little of the honey. Should we not, under the circumstances, treat these little Old Men of the Sea with much lenity or even with something akin to affection?

During the coming spring I shall endeavor to make a more detailed study of the habits of *A. donisthorpei* and of the other species *A. wasmanni*, which, to judge from its longer appendages, must be an even more persevering and impudent beggar. For the present I shall confine myself to giving a description and several figures of both sexes of the two species, so that they may be easily recognized by other students of our North American myrmecophiles.

Antennophorus donisthorpei sp. nov.

Male. (Figs. 1, 2, 4 and 8.) Body nearly as broad as long, broadly oval or subtrapezoidal, broader behind than in front, with very obtuse anterior and posterior borders, the latter in some specimens almost straight. In

profile the dorsal scute is only moderately convex. Dorsal surface and legs yellowish brown, the former smooth and shining, not polygonally areolated under a high magnification, with a darker brown, O-shaped vitta enclosing a large, elliptical, pale central area and separated by a pale border from the edge of the dorsal scute. Ventral surface of body yellowish; sternal and anoventral scutes brownish. Dorsal surface densely clothed with short, rather stout hairs, which are distinctly longer and sparser in front and on the sides than behind. Legs short and stout, anterior border of coxa and trochanter of three posterior pairs not laciniate-denticulate, but entire. Hairs on the three posterior pairs of legs short, stout and distinctly curved, especially towards their tips. Sternum in some specimens connected with the lageniform anoventral scute by a pair of slender processes, which surround the genital orifice. In other specimens (Fig. 2) the two processes are separated from the anoventral scute, and in still others they may be continuous with this sclerite but separated from the sternum. Hairs on the sternum and anoventral scute very short and sparse. Chela rather small, its fixed digit flattened, spatulate and curved, terminating in a round knob; movable digit dilated at the tip where it is bilobed, with one of the lobes folded back.

Length: 750–790 μ; breadth: 700–800 μ.

Female. (Figs. 3, 5, 6 and 7.) Resembling the male in form and coloration, but somewhat larger. Sternum large, median and entire, with a very few short hairs on its posterolateral portions. Anoventral scute subcordate, prolonged anteriorly as a slender tapering process which terminates between the lips of the genital scutes; covered behind with short, sparse hairs. Genital scutes resembling those of *A. foreli* Wasm. Chela with slender tapering digits, pointed and hooked at their tips and armed on their inner edges with very minute, blunt denticles.

Length: 760–825 μ; breadth: 780–980 μ.

Described from several males and females taken May 8th, 1909 on the Faulkner Farm, near Forest Hills, Boston, Mass. They were attached to the gular surface of workers of the following ants: *Lasius flavus* L. subsp. *nearcticus* Wheeler; *L.* (*Acanthomyops*) *latipes* Walsh; *L.* (*A.*) *claviger* Roger and *L.* (*A.*) *interjectus* Mayr.

The new species, which I dedicate to Mr. H. S. J. Donisthorpe, the well-known student of British myrmecophiles, seems to be most closely related to the European *A. foreli* Wasm., but the shape of the body is more trapezoidal, the hairs on the dorsal surface are shorter and more abundant, the pale dorsal area is larger, the chelar digits of the female have much smaller and blunter teeth and a different flagellum, and the male chela is of a very different shape, to judge from the figures of Berlese and Karawaiew.[1] The sternum of the

[1] Weitere Beobachtungen uber Arten der Gattung Antennophorus. (Russian) *Mem. Soc. Natur. Kieff.* XX, 1908, pp. 209–230, 1 fig.

female is much longer and very different in outline and the anoventral scute is less tapering in front.

Several of the female specimens of *A. donisthorpei* each contain a single, large, mature egg, as shown in Fig. 3. This seems to indicate that *Antennophorus*, unlike many other mites and the ticks, is in the habit of producing only one egg at a time. This egg is perhaps attached to the surface of the ant which is infested by the mite.

Antennophorus wasmanni sp. nov.

Male. (Figs. 10, 11, 12, 13 and 15.) Body very convex above, nearly as broad as long, very broadly oval, distinctly wider behind than in front, with its anterior and posterior ends very obtusely angular. Upper surface smooth and shining, polygonally areolated under a high magnification, brown, without a darker vitta or perceptibly paler central area, and covered with longer, more slender and somewhat sparser hairs, than the preceding species. Legs and scutes of the ventral surface brownish, remaining portions yellowish. Legs decidedly longer than in *A. donisthorpei*, coxæ and trochanters of three posterior pairs not laciniate-denticulate. Hairs on these pairs of legs very long and straight. Anoventral scute broad in front, connected with the sternum by two slender bands which enclose the genital orifice. Chela very long; digits slender, subequal, the fixed one simple but not spatulate, its tip curved, blunt and finger-like; the movable digit with a hooked, pointed tip and a flattened, lobular process (adnate spur) on its outer side.

Length: 900 μ; breadth: 830 μ.

Female. (Figs. 14, 16, 17 and 18). Resembling the male in form and coloration but somewhat larger. Body broader than long. Sternum larger, subelliptical, median, entire and apparently nude. Anoventral scute short, subcordate, with a rapidly tapering anterior process that terminates between the genital scutes. The latter resemble those of the preceding species and *A. forelii*. Hairs on the anoventral scute very short and sparse. Chela with subequal digits, each terminating in a hooked point, their inner borders armed with larger denticles than in the preceding species and one large tooth on the movable digit.

Length: 990 μ; breadth 1040 μ.

Described from two males and two females taken May 22d, 1909, on the Faulkner Farm at Forest Hills, Boston, Mass., with workers of *Lasius umbratus* Nyl. var. *aphidicola* Walsh. The mites were not seen till after they had been killed in alcohol with their hosts.

This species is dedicated to the Rev. E. Wasmann, S. J., who has contributed so much to our knowledge of the myrmecophilous insect of all lands. It may be readily distinguished from the preceding species by its much more convex dorsal surface, longer legs, the longer

and straighter hairs on the three posterior pairs of these appendages and the shape of the chelæ of the two sexes. Like the preceding species, *A. wasmanni* seems to be most closely allied to the European *foreli* in having an undivided sternum in the female. In the convexity of its body it resembles *A. pubescens* Wasm., but the male chela is of an entirely different shape, the female sternum is entire and there are fewer hairs on this sclerite and on the anoventral scute of both sexes.

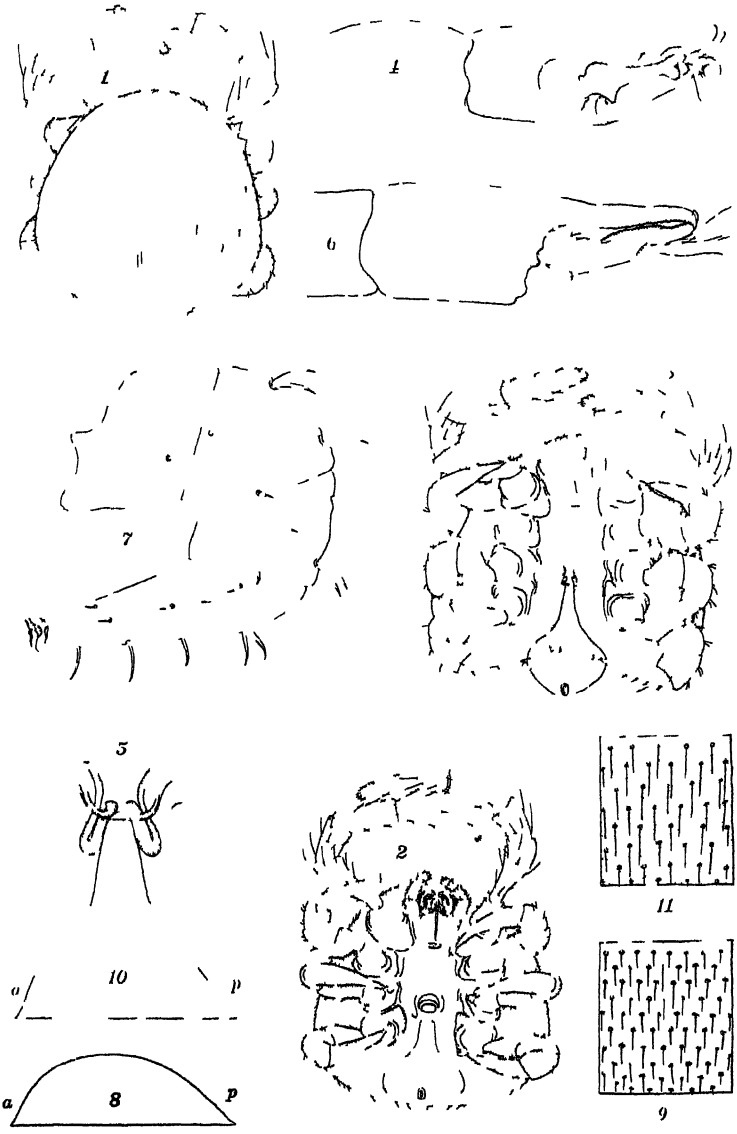
EXPLANATION OF PLATES.

Plate I.

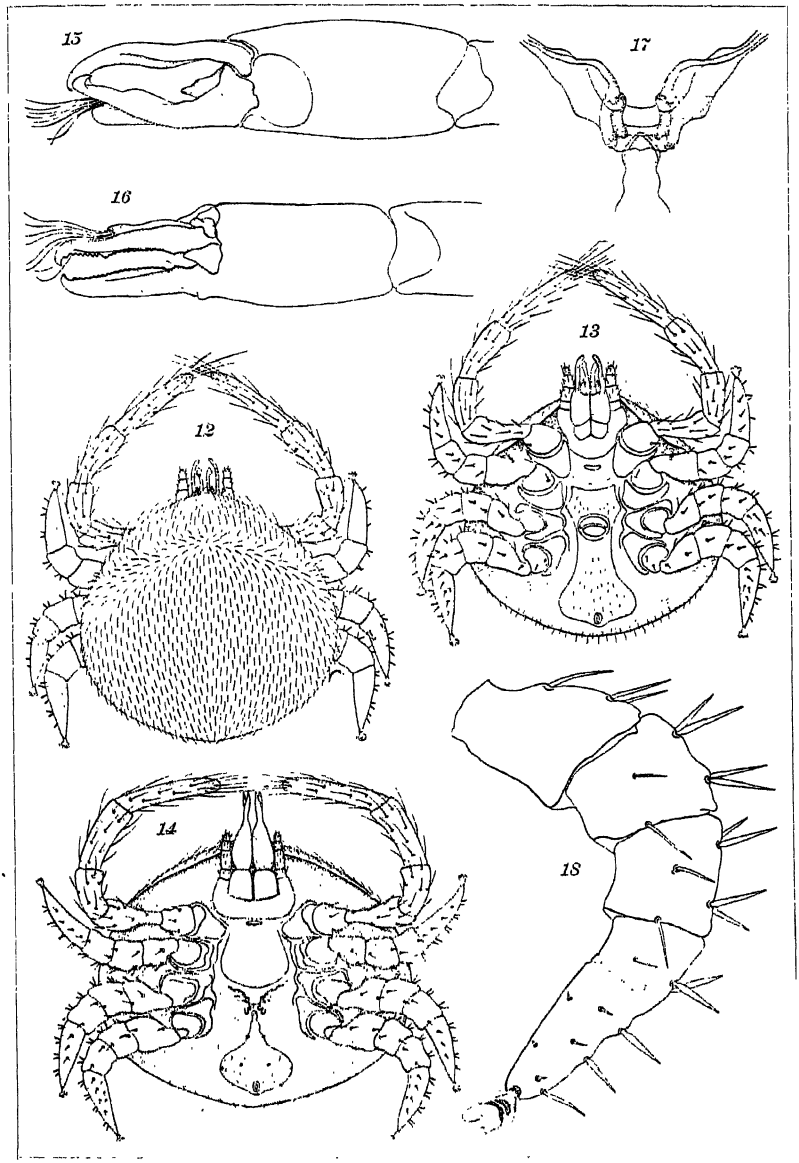
Fig 1. *Antennophorus donisthorpei* sp. nov , male, dorsal view.
Fig 2. Same, ventral view.
Fig 3. Female *A donisthorpei*, ventral view.
Fig. 4. Chela of male, ventrolateral view
Fig 5. Genital scutes of female.
Fig. 6. Chela of female; dorsal view.
Fig 7. Left hind leg of female, ventral view.
Fig 8 Dorsal scute of *A. donisthorpei*, in profile, *a*, anterior, *p*, posterior end.
Fig. 9 Portion of dorsal integument near posterior end of body.
Fig. 10. Dorsal scute of *A. wasmanni* sp. nov , in profile, *a*, anterior, *p*, posterior end.
Fig. 11. Portion of dorsal integument of *A. wasmanni* near posterior end of body.

Plate II.

Fig. 12. *Antennophorus wasmanni* sp nov.; male, dorsal view.
Fig. 13. Same, ventral view.
Fig. 14. Female, ventral view.
Fig. 15. Chela of male, ventral view.
Fig. 16. Chela of female, ventral view.
Fig. 17. Genital scutes of female.
Fig. 18. Left hind leg of female, ventral view.



WHEELER MITES OF THE GENUS ANTENNOPHORUS



WHEELER — MITES OF THE GENUS ANTENNOPHORUS.

A REVISION OF THE SPECIES OF AGATHOMYIA OF THE EASTERN UNITED STATES.

By Charles W. Johnson.

Boston Society of Natural History, Boston, Mass.

Table of Species.

1. Head, thorax and abdomen black..... .....2.
   Head black, thorax and abdomen fulvous.... .....**fulva** Johns.
2. Abdomen broadly banded with yellow, scutellum yellow. **pulchella** Johns.
   Abdomen not banded..... .....3.
3. Thorax and abdomen both maculated with greenish white, halteres black..... .....**notata** Loew.
   Thorax only maculated with greenish white, halteres yellow. **divergens** Loew.
   Thorax and abdomen without maculations, tip of abdomen in the female cinereous, knobs of the halteres black.....**talpula** Loew.

Agathomyia fulva Johnson.
Callimyia fulva Johns., Psyche XV, p. 59, June, 1908.

At the time I described this and the following species, I did not have access to Verrall's work on the British Flies. A further study of these, together with the types of *divergens* and *talpula* Loew, shows that the four species are all true *Agathomyia*.

Agathomyia pulchella Johnson.
Callimyia pulchella Johns., Psyche XV, p. 58, June, 1908.

Since describing this species from specimens obtained at St. Johnsbury, Vt., June 27, 1906, I have collected two specimens on Mt. Ascutney, Vt., July 11, and one at Brattleboro, Vt., July 15, 1908.

Agathomyia talpula Loew.
Callomyia talpula Loew, Centur., IX, 81 (1869).
Callimyia talpula Johns., Psyche XV, p. 59 (1908).

A female of this species was obtained at East Walpole, Mass., May 26, 1908.

Agathomyia divergens Loew.
Callomyia divergens Loew, Centur., V, 77 (1865)

Aside from the type there is a specimen in the Museum of Comparative Zoology, from the District of Columbia.

Agathomyia notata Loew.

This species has been obtained by the writer at Westville, N. J., July 2, 1893; Riverton, N. J., June 1; Auburndale, Mass., August 28; and Hanover, N. H., July 5, 1908.

Callimyia venusta Snow.

I was very much surprised to capture at Shackford Head, near Eastport, Maine, July 14, 1909, a specimen of this beautiful species, agreeing in every respect with the description. It is a true *Callimyia*.

Unusual Parasitic Habits of an African Ephydrid. By Dr. C. Wellman, translated from Zeitschr. wiss. Insektenbiol., Nov. 18, 1909, p. 356.

While collecting insects some time ago in West Africa, a small fly which was laying eggs on living ants (Cremastogaster sp.) attracted my attention. The fly rested on her victim, inserted her ovipositor, and then carried the seemingly perplexed and helpless ant into a small deserted spider burrow, where the ant remained until the fly larva had emerged. It was interesting to see how well the fly managed so strong a fighter as the ant, for this ant can sting severely. At first I mistook the fly for a Phorid as I knew *Phora formicarum* to be parasitic on *Lasius niger*, but on closer examination by specialists, it proved to be a member of the Ephydridae representing a new genus and species. I take this occasion to present these observations as this kind of parasitism is to my knowledge something entirely new among Diptera.

B. B. B.

THE CHALCIDOID PARASITES OF THE COMMON HOUSE OR TYPHOID FLY (*MUSCA DOMESTICA* LINN.) AND ITS ALLIES.[1]

By A. A. Girault and George Ethelbert Sanders.

The University of Illinois.

Habits in General and Biology.

A. *Oviposition.* This appears to be the only function of the female. When thus engaged she is not easily disturbed and the function is normally performed even in small capsules or vials, and in the insectary at various times, females were often observed attempting to gain entrance to breeding-cages containing their hosts; in the case of large cages they were quite often successful and under certain conditions it was impossible to keep them out. The following detailed, though fragmentary observations were made on ovipositing females.

(1) Sept. 12, 1908.— The female often faces towards the caudal end of the host puparium when engaged in ovipositing — on this date, in the cases of 8 host puparia (*Phormia regina*), apparent oviposition was observed once in four cases and twice in the other four — the times of these ovipositions were between 9:55 A. M. and 1:20 P. M. and the time required to deposit a single egg varied from 1½ minutes to 16, averaging 7½ minutes; the particular spot on the host puparium into which the ovipositor of the female was inserted was usually in the region of the 4th and 5th segments, but varied to the 6th and 7th or 7th and 8th. The hole made by the ovipositor was not distinct afterwards, but in many cases it became covered with a white mycelium-like growth the nature of which we have not determined. (2) On Sept. 29, 1908, at 11:30 A. M., in the case of three virgin females ovipositing into the puparia of *Phormia regina*, the ovipositor was inserted for its full length for 3, 7 and 8 minutes respectively. (3) On Sept. 13, 1908, a female was watched while ovipositing into a hard puparium of the Phormia. The puparium was pierced by rotating the ovipositor and pressing it down, the force of the pressure often causing the organ to bend, when the rotary motion was more easily seen; this continued

[1] Continued from Vol. XVI, p. 132.

for 11 minutes; the abdomen, during this time, was inclined upward, its tip applied to the surface and the ovipositor appearing as a perpendicular rod issuing from the venter slightly beyond the proximal third. After drilling through the crust of the puparium, the rotary motion was considerably lessened but not entirely discontinued and 10 more minutes were consumed in working the ovipositor back and forth, apparently in order to enlarge the aperture, the edges of which were frayed. The ovipositor was then pushed farther into the aperture, the abdomen moving up and down slightly and gradually being triangularly or conically produced at the base of the ovipositor, and as the latter entered farther, approaching nearer and nearer to the surface of the puparium, until after 30 seconds the ovipositor was fully inserted. The female then remained motionless for 3⅝ minutes, when the ovipositor was partially redrawn and reinserted two or three times, and finally wholly withdrawn from the host, assuming its usual concealed position within the valves along the venter. Upon the withdrawal of the ovipositor, the female immediately left the host. The time that she was engaged in the whole operation was 25½ minutes. (4) Observations made on three females depositing eggs into puparia of the Phormia, on Sept. 29, 1908, showed in three instances that the ovipositor was fully inserted for 70, 90 and 95 seconds respectively. (5) On Sept. 18, 1908, a female of this parasite was confined in a small homeopathic vial with a quantity of muscid puparia of varying ages — some three or four days old, some but several hours. The female chose an "old" puparium, formed about two days, and apparently deposited three eggs into it, one following the other. At first, she chose a place for inserting the ovipositor by examining closely the entire surface of the host; the ovipositor was then guided to the spot by bending the abdomen, the whole body convexly bent, the head turned as though the insect was watching the operation; as soon as placed, the ovipositor was released from the valves along the venter and the abdomen assumed its usual position. Piercing the shell of the puparium required 1½ minutes; the ovipositor was then inserted for its entire length, without other delay, and as quickly withdrawn, fifty seconds being occupied in enlarging the hole. After this short period of time, the ovipositor was pushed in again for its entire length, remaining so for forty-five seconds, during which time, apparently, the egg was deposited. After the ovipositor was withdrawn, the parent parasite carefully examined the puncture with the antennae

and mandibles and apparently also by means of sight. (6) The deposition of an egg observed at 9:45 P. M., Sept. 14, required 16 minutes; the host was *Phormia regina*. Another observation made at 10:15 A. M. the same day, showed that the act required 8 minutes; the host puparium was that of *Musca domestica*; in the latter case, the ovipositor was inserted into the 9th segment of the host. A female was observed to deposit an egg in confinement at 7:30 A. M. to-day. (7) A female confined at 9:20 A. M., Sept. 10, deposited into puparia of the Phormia at 9:32 A. M. and 1:20 P. M. the same day. One confined at 10 A. M. the same date with 2 puparia of the same host oviposited at once. (8.) In the cases of 4 females confined separately in vials each with 4 (in one case 8) puparia of *Cynomyia cadaverina* Desv., April 29, 1909, oviposition occurred with one female at 10:25 P. M., April 30, and again at 9 P. M., May 1; no other observations were recorded. (9.) Nine males and twenty females confined at 11:20 A. M., April 29, with 10 puparia of the same host commenced oviposition about noon, or sooner, and oviposition was observed at nearly every hour between 9 A. M. and 11 P. M., for several days.

B. *Nature of the Parasitism.* Examinations made of parasitized hosts, showed that in all cases, the parasite is "social" or gregarious and does not attack the host until after the formation of the puparium, preferably after the latter has been formed for at least twenty-four hours. Puparia of *Phormia regina* examined, were in some cases filled entirely with the larvae of the parasite which had totally consumed the host pupa; for example, from one puparium 47 larvae of the parasite were removed; from another 8 larval parasites were removed, together with a shriveled pupa of the host — none of the parasitic grubs had entered the body of the latter, which indicates that the parasites are external as far as the host pupa is concerned, obtaining their nourishment by means of absorption; in the case just cited, one of the parasitic larvae was attached to the head of the host pupa over the eye, one to the thorax and six to the abdomen. In a third Phormia puparium, there were found 21 larval parasites, the host pupa being totally consumed; in four more single cases there were 8, 13, 13 and 16 larvae of the parasite respectively. In another, 27 parasitic pupae were found, from a single puparium of *Sarcophaga* sp. "c" 22 ♂♂ and 4 ♀♀ of the parasite were taken. As a rule, the remains of a parasitized host — the fully formed pupa — is a flat, scale-like mass apparently consisting of the ventral shell of the pupa and that of the head; for

example, the thecae of the eyes, legs and wings are discernible, and the remains are not much shrunken, so far as the original length is concerned. In the case of *Cynomyia cadaverina*, in one puparium infested with 21 larvae of the first spring generation, the parasites were all attached to the dorsal surface of the host from the pronotum to the tip of the abdomen; these parasitic larvae were nearly full-grown. But in another puparium of the same host, in which 13 larvae were found, their attachment to the host appeared to be haphazard, and the host pupa was considerably shrunken, especially in width. It is evident, from their appearance, and from the fact that the larger larvae are found attached externally to the host — between it and the inner walls of the puparium — that the larval parasites obtain their nourishment through the body wall of the host pupa, leaving the integument intact. In both of the latter cases, the host pupae were nearing the final ecdysis when they were attacked by the parasites.

Although gregarious, the host is not as completely destroyed as by *Spalangia*, *Muscidifurax* or *Pachycrepoideus*, which though solitary parasites, reduce the host to a mere flat unrecognizable shell.

In addition to the foregoing, Mr. Maurice C. Tanquary has kindly collated the following records from our rearing notes:

TABLE I. NUMBER AND SEX OF PARASITES (*Nasonia brevicornis*) ISSUING FROM PUPARIA OF *Phormia regina*.

Males	Females	Larvae.	Total.	Males.	Females.	Larvae.	Total.
8	7		15	0	5		5
3	6		9	0	1		1
10	4		14	5	0		5
5	3		8	9	6		15
1	13		14	1	6		7
9	5		14	6	16		22
10	17		27	0	5		5
7	6		13	16	5		21
13	11		24	0	7		7
4	9		13	2	12		14
6	15		21	1	4		5
0	17		17	3	9		12
15	5		20	3	8		11
1	21		22	7	12		19
10	4		14	6	4		10
4	6		10	1	10		11
6	7		13	3	9		12

Males.	Females.	Larvae.	Total.	Males.	Females.	Larvae.	Total.
5	4		9	9	13		22
7	1		8	9	10		19
1	10		11	7	5		12
17	0		17	10	9		19
2	7		9	4	5		9
4	11		15	0	4		4
4	10		14	11	8		19
1	6		7	11	4		15
3	7		10	11	18		29
2	11		13	1	0	5	6
2	3		5	5	4		9
5	11		16	2	0		2
11	0		11	2	6		8
1	9		10	0	4		4
17	5		22	3	1		4
38	4		42	5	1		6
6	10		16	10	11		21
1	2		3	3	4		7
1	2		3	13	4		17
4	7		11	5	10		15
15	4		19	4	2		6
6	0		6	1	10		11
5	1		6	2	8		10
5	5		10	22	6		28
11	0		11	3	2		5
5	14		19	3	8		11
0	4		4	9	6		15
9	11		20	9	3		12
6	5		11	8	5		13
2	1		3	0	2		2
15	12		27	23	11		34
8	8		16	4	2		6
1	7		8	4	5		9
2	1		3	9	3		12
7	9		16	6	9		15
8	12		18	9	3		12
9	3		12	7	1		8
0	6		6	1	2		3
7	9		16	3	7		10
12	7		19			8	
4	12		16			6	
0	3		3			6	
9	13		22			4	
7	11		18			6	
1	9		10			23	
3	8	3	14	3	3		6
			Totals	713	789	61	1555

The puparia from which the foregoing records were made were selected at random from a large quantity formed by maggots obtained August 28, 1908, in the decomposed cadaver of a large angora cat, taken from the city dumping-grounds, Champaign, Illinois. Each puparium was confined separately in a gelatine capsule, until the parasites emerged; they were confined on Sept. 15, and on Sept. 29 the majority of the parasites had emerged; the count was not made, however, until nearly a month later, or on Oct. 19, 1908.

In 119 puparia there were 1496 individuals of *Nasonia brevicornis*, of which 710 were males and 786 females. The average number of males in each puparium was 5.96, of females 6.60; the average number of specimens from each puparium was 12.57. Of the whole number, 52.4% were females and 47.6% males. The averages do not include 8 larvae found in two of the hosts.

On the date of counting — October 19th — 8 of the puparia were found to contain larvae of the parasite, some in addition to the adults, over half of the larvae being still alive; but 14 of the puparia contained only dead pupae of the host, that is to say, were not parasitized. So that of the 140 puparia examined, 14 were not parasitized, 126 were. The total number of parasites in the 126 parasitized puparia, including larvae, was 1555, and on this basis, the average for each host was 12.34, very near the former average. The maximum number of parasites obtained from a single host (*Phormia regina*) was 47, recorded in the first paragraph of this section; the minimum was 1, recorded in the table.

The meconial discharges of this parasite, found scattered through the host puparium, are brownish yellow or dark olive green in color and consist of small conglomerations of round pellets, or are sometimes in irregular chains like some bacteria, but are never single, solid pieces as with *Pachycrepoideus*, *Spalangia* and *Muscidifurax*.

C. *Length of the Period of Oviposition.* In the cases of two females captured and confined together with eight puparia of *Musca domestica* at 11:30 A. M., Sept. 10, the first oviposition was observed at 1 P. M., Sept. 10, the second at 7:30 A. M., the following day, the third at 10 A. M., Sept. 14, and the fourth and last, fifteen minutes later; here, at least, oviposition was continued over a period of 3½ days or more.

In the case of 9 males and 20 females, parents of the first spring generation of 1909, which were confined at 11:20 A. M., April 29, 1909, with 10 healthy puparia of *Cynomyia cadaverina* which were

freshly emerged (average, 9 A. M., April 29) and of the same age, oviposition was begun at noon the same day and continued steadily until at least 9 P. M., May 2, 1909, when further observations were interrupted. These facts also hold for a single female of the same lot confined separately with 8 of the hosts.

D. *Time Elapsing between Emergence and Reproduction.* Eleven adults of mixed sexes emerging from a single puparium of *Phormia regina*, from 11:45 A. M. to noon, Sept. 28, 1908, were at once confined together with four healthy puparia of the same host. At noon the following day oviposition was observed, or after a period of twenty-four hours. One pair of adults emerging at 8 A. M., Sept. 30, was confined immediately with seven healthy puparia of the same host; at 8:13 A. M. mating was observed and at 6:50 P. M. the same day the female was observed ovipositing; or after 10½ hours. Mating in this instance followed almost immediately after emergence, and lasted for 14 seconds. In the case of the parents of the first spring generation of 1909, mating followed almost immediately after emergence and oviposition about 3 hours later.

E. *Duration of the Pupal Stage.* This was obtained in one case only. A larva pupated during the night of Sept. 17–18, 1908, the newly formed pupa being yellowish white; by the twenty-first of the same month, the pupa had assumed nearly the colors of the adult, dark greenish, the head and thorax coloring first, the abdomen a few hours later. The resulting adult female emerged at 10 A. M., Sept. 23, 1908, making a pupal stage of approximately 5½ days. The average length of this stage for the first spring generation (17 cases) was 9 days (May 14–23, 1909).

F. *Length of the Life Cycle.* The few incidental observations obtained on this point are herewith given in tabular form. (Table II, p. 16.)

Thus while the average daily effective temperature shows a gradual decrease, there seems to be no corresponding increase in the duration of the cycle.

The duration of the cycle appeared to be somewhat longer in the case of the first spring generation, however, when the daily average effective temperature was low. Thus, hosts exposed to recently mated adults from noon, April 29, 1909, to late on May 2 — oviposition continuing throughout that time — were filled with the nearly full-grown larvae of the parasite on May 13, pupation com-

TABLE II. DURATION OF THE LIFE CYCLE IN *Nasonia brevicornis*, 1908.

Lot No.	Host.	Oviposition observed.	Emergence of adults.	No.	Approximate length of cycle, days.	Degrees Fahr. Effective tmp.[1]	
1	*Musca*	Sept.9–10	Sept.26	6 ♂'s, 10 ♀'s	16	35.9°	574.0° (Sept. 10–25).
2		Sept.10, 11 a.m.	Sept.28	1 ♂, 2 ♀'s	18	35.3°	634.7° (Sept. 10–27).
3		Sept.10, 1 p.m.	Sept.25, 10 a.m	9 ♂'s, 12 ♀'s	14⅞	36.2°	538.3° (Sept. 10–25).
4		Sept.10, 10 p.m.	Sept.25, 10 a.m.	1 ♂, 6 ♀'s	14½	35.5°	514.9° (Sept. 11–25).
		Sept.11	Sept.28	2 ♂'s, 17 ♀'s	17	34.3°	578.6° (Sept. 12–28).
6	*Phormia*	Sept.14, 7 a.m.	Oct.1, 7 a.m.	2 ♂'s, 8 ♀'s	17	31.4°	533.9° (Sept. 14–30).
7		Sept.18, 6 p.m.	Oct.2, 9 p.m.	7 ♂'s, 12 ♀'s	14⅛	28.3°	408.1° (Sept. 18–Oct.2).
8		Sept.29	Oct.15	17 ♂'s	16	19.6°	314.3° (Sept. 30–Oct. 15).
Av.[2]				14	15.9	32.6°	512.1°

mencing on May 14 at the average time of 4 P. M. Emergence of the adults occurred at 4 P. M., May 22, becoming general at 3 P. M., May 24. Hence, taking average time, the life cycle in this case had an average duration of 22½ days, natural temperatures.

G. *Progeny of a Single Female.* The number of observations which we were able to make concerning the fecundity of the species was not large, but those which are tabulated in the attached table (table III) appear to show that there is quite a wide range, within certain limits, which is more or less dependent upon the number of host puparia available for purposes of oviposition and also the host species. For instance, it is at once noticed that the most productive females had access to a comparatively large number of the host

[1] Inception of development taken as 43° Fahr. Sums of daily averages.
[2] Daily averages.

puparia, of which they made use for purposes of oviposition, whereas those having access to but one or two host puparia, especially those of the smaller host, *Musca domestica*, produced the least progeny. These experiments were performed at various times in the laboratory and are by no means conclusive, that is, do not establish the range or average of fecundity.

TABLE III. PROGENY OF SINGLE FEMALES OF *Nasonia brevicornis*.

Female No.	Date, 1908.	Host.	No. of hosts exposed.	No. of hosts infested.	Progeny of single females.			Minimum.	Maximum.	Range.
					♂'s.	♀'s.	Total.			
1	Sept. 25	*Musca*	1	1	1	6	7			
2			1	1	4	6	10			
3			1	1	5	6	11			
4		*Phormia*	1	1			27			
5			2	2			38+[1]			
6			4	4			39			
7	Sept. 28	*Musca*	4	4	2	17	19			
8			1	1	1	2	3	3		
9	Sept. 30		1	1	2	4	6			
10	Oct.	*Phormia*	5	4	9	18	27			
11	Oct. 1		1	1	2	8	10			
12	Oct. 20		Many	—	7	12	19			
13			Many	—	4	22	26			
14			130	17	21	57	78			
15			86	22	38	65	103		103	100
16		*Chrysomyia*	17	12	31	53	84			

It is thus seen that in one instance, a female was able to parasitize successfully 22 host puparia and another 17, when quite a number were available. The observations do no more than indicate the probabilities and possibilities of fecundity for the species. Apparently, all of the females concerned were fertilized. From the fact that single ovipositions take so much time, as well as for other reasons, we strongly suspect polyembryony in this connection.

H. *Proportion of the Sexes.* The following results, recorded in table IV, comprise actual counts of over seven thousand specimens, including practically every individual of this parasite reared or observed by us during the period of breeding, excepting one thousand individuals of mixed sexes released for experimental purposes.

[1] All from one of the puparia; the numerous larvae in the other died and were not counted.

The specimens are from various sources, but the great majority were reared from puparia obtained under natural conditions, so that the general result should show a nearly normal or actual ratio of the sexes. The table follows.

TABLE IV. PROPORTION OF THE SEXES IN *Nasonia brevicornis*.

Lot No.	Source.	Date. 1908.	Males.	Females.	Total.	Ratio.	Remarks.
1	Principal misc. rearings during season	Sept. 9–Oct. 20	142	438	580	1 3	Comprises all accessioned rearings. See pp. 7-9.
2	Nason Collection	May 11–Sept. 17 1894–1895	1	9	10	1.9	From sweepings, Algonquin, Illinois.
3	*Phormia regina*	Sept. 29	710	786	1496	1:1+	From a single host lot from a decomposed cadaver, city dumping-grounds.
4	*Phormia regina*	Oct.	1895	2808	4703	1 1+	Same as lot No. 3, later, excluding 1000 removed at random for experimental purposes.
5	*Phormia regina*	Oct.	228	116	344	2:1+	Host puparia in fecal matter, miscellaneous.
6	Various	Sept.	41	49	90	1.1+	Reared.
7	Various	Sept.–Oct.	64	82	146	1:1+	From isolated puparia of *Musca, Sarcophaga, Phormia and Chrysomyia.*
Sums:			3081	4288	7369	1:1+	
Per-cent.:			41.81%	58.19%			

The general result shown in the table is about what one would expect if consideration is taken of the fact previously pointed out, namely, that the species is occasionally parthenogenetic, which, however, follows no general law in the Hymenoptera. It should be explained, in regard to lot No. 4 in the table that, after it was separated from lot No. 3, the first 1000 individuals of mixed sexes coming to

the light were removed and released to be used in an experiment to test artificial propagation. Unfortunately, these were not counted in regard to sex, so that it is unknown whether the females greatly predominated, a result which we were led to suspect from the fact that this sex appeared to be more attracted to light; for the first 932 individuals taken from the experiment, after all emergences, were females, dead in the exit-tube, which alone was light. Lot No. 3 is the most complete record made, none of the emerging parasites having escaped, and we are inclined to think that it represents the actual ratio of the sexes, the females slightly predominating.

The proportion of the sexes in a small number of the parasites which hibernated as larvae, hence the parents of the first spring generation, was as 37 males are to 61 females; these emerged during the last day of April, 1909. Their descendents or parents of the 2d generation were also of mixed sexes, being the progeny of fertilized females, there being 24 males to 45 females, which emerged on May 25, 1909.

I. *Emergence of the Adult.* In general, it may be stated that the adult parasites emerge from the host puparium through from 1 to 3 circular holes, situated variously, usually in the dorsal or dorso-lateral aspect; and when more than one exit-hole, the two or three are usually scattered or widely separated. The manner of emergence does not differ for sex. The exit-hole varies in diameter from about 0.75 to 1.50 mm.; it is usually larger and single when the host is *Musca* or *Chrysomyia* and smaller when *Phormia*, though this difference may be more apparent than real. Individual exit-holes may of course vary considerably in shape; for rarely it may involve the whole of one end of the host puparium and is then relatively very large and irregular. The margins of the exit-holes are always jagged or serrate, showing that the adults gnaw their way out. Specific instances may better illustrate.

From a single puparium of *Musca domestica*, 1 male and 6 females issued from a single dorsal exit-hole just behind the head end; several parasites of both sexes issued from another puparium from a hole in the dorsal aspect of the 7th segment; several adults of both sexes issued from a third puparium through two exit-holes in the cephalic and caudal segments respectively. Again, 1 male and 2 females emerged from a more irregular exit-hole in the dorso-lateral aspect of the caudal or anal segment of the host. In a last case recorded, 2 ♂♂ and 4 ♀♀ issued from a single hole near the cephalic end of the host.

In the case of *Phormia regina*. From one puparium, 7 females issued from a single hole in the lateral aspect of the 3rd segment; from a second, 37 males issued from 2 holes in the ventro-lateral aspect of segments 2 and 5; from a third 15 males issued from a single hole in the dorso-lateral aspect of segment 5; from four more puparia, of the same lot, 9 males and 18 females issued, making but a single exit-hole in each of the hosts. In each of the following instances several parasites issued in the manner stated; both sexes were present:

(a.) 2 similar holes in a longitudinal line, dorsal aspect of 2d and 4th segments. (b.) 3 holes, lateral aspect, 2 on one side at segments 3 and 7, the other at segment 2 on the opposite side. (c.) 2 holes, lateral aspect of segment 5 and tip of the anal segment. (d.) 2 holes, dorsal aspect of segment 3 and dorso-lateral aspect of the anal segment. (e.) 2 holes in an oblique line, dorsal aspect, 5th and 7th segments. (f.) 1 hole, lateral aspect of segment 3. (g.) 1 hole lateral aspect of segment 6. (h.) 2 holes, opposite sides, lateral aspect of penultimate segment and dorso-lateral aspect of segment 7. (i.) 3 holes, scattered. (j.) 2 holes. (k.) 2 holes caudal end, dorsal and ventral aspects of the penultimate segment.

With *Chrysomyia*, several adults issued from a single puparium through a single hole in the dorso-lateral aspect of the cephalic segment; from 12 puparia of this species, there emerged 32 males and 64 females, or an average of 8 to each; in the case of 8 of the puparia, but a single exit-hole was present, nearly all in the dorsal aspect of the 3d, 4th, 5th and 8th segments; the remaining 4 hosts bore each 2 exit-holes, usually widely separated.

In *Cynomyia cadaverina* Desv., 8 ♂♂, 16 ♀♀ issued from a single puparium from two equal round holes in the dorso-lateral aspect of segments 3 and 5.

In regard to the time of emergence, the males usually emerge from 2 to 20 hours earlier than the females, a few emerging some hours previous to the simultaneous emergence of the majority, but there is considerable variation in individual cases. Thus some males may be the last to emerge, but the tendency is for them to emerge earlier than females.

J. *Local Abundance.* In order to show the local abundance of this parasite during 1908, we have merely to point out the fact that as many as eight thousand or more specimens were reared by us during the months of September and October. This large number

was reared quite incidentally, that is to say, without conscious effort on our part to augment it. From one experiment alone, there were obtained as many as seven thousand specimens, in round numbers, though we have no knowledge concerning the number which may have escaped. Further, the local abundance of this parasite is indicated by the fact that in at least a portion of the experiment just mentioned, a portion selected at random, the percentage of parasitism was as high as 90 per cent. We have evidence to show, on the other hand, that this percentage of mortality of the host was by no means general but was considerably lower on the average for this season of the year.

Thus, apparently this parasite had concentrated its attack at certain spots and while common over this locality was not exceedingly abundant over the whole, as the percentage of mortality given in the instance just mentioned would seem to indicate.

It was the most abundant parasite present in our experiments and also the one which attacked the greatest numbers of different muscid hosts, the remaining chalcidoid parasites of importance mainly confining themselves to the house fly.

K. *Artificial Propagation.* An unsuccessful attempt was made during the last week of September, 1908, to test the effect of the artificial propagation of this parasite on a badly infested garbage heap at the city dumping-grounds, Champaign, Illinois. The attempt was made too late in the season, however, and in addition, bad weather immediately following their liberation undoubtedly prevented activity on their part.

On the afternoon of September 23, 1000 specimens of mixed sexes were scattered over the garbage heap, which at that time was a veritable breeding experiment on a large scale. Soon after their liberation, many of the parasites were noticed crawling over host puparia which had been formed about a half-inch below the surface of the soil along the edges of the garbage heap. Specimens other than those liberated were not noticed at the time, special search being made for them previous to liberation.

On the date the experiment was inaugurated the percentage of parasitism by this species was very low as we know from the results obtained from a collection at random of 186 puparia; for by November 6, 1908, 48 adult flies had emerged (of which 37 were *Musca domestica*), 6 *Spalangia* and 2 *Muscidifurax raptor* Girault and Sanders MS. An examination made of the remaining 130 hosts, which were hibernat-

ing in confinement as puparia, revealed the fact that the majority had died and that no further parasitism had occurred. After inauguration of the experiment, weekly collections of the host puparia were made from the heap of garbage and continued until the first week of November. The lot collected on September 30 had one puparium infested with *brevicornis* but from those collected thereafter no results were obtained, the collections unfortunately being placed in the warm insectary and subsequently neglected. Nor were any adults of the parasite seen during the visits to the heap in the late fall and early winter. From a lot of hosts collected on November 14, however, the garbage then being covered with snow, sometime during late November single females of *brevicornis* issued from a puparium of *Chrysomyia macellaria* and from one of *Phormia regina*; these were evidently greatly accelerated in development by the warmth of the insectary and would otherwise have hibernated within the puparia of the hosts. The remaining lots were examined early in the spring of 1909, but everything was dead and no indications of parasitism were found.

L. *Hibernation.* This parasite hibernates as a full-grown larva in the puparia of its various hosts, pupating early in the spring and emerging shortly afterwards, the earliest record being April 28, 1909 — in numbers the following day. The following data have been gathered concerning this phase in its life-cycle.

Case I. On April 28, 1909, a single broken puparium of *Chrysomyia macellaria* was found in a vial in the cold insectary which had evidently been laid aside late in the previous October and subsequently overlooked. The vial had no data connected with it, so that the origin of the single host could not be traced. With the broken puparium were found a living male adult, partly excluded from the pupal integument and four healthy pupae of the parasite, two of which were uniformly deep black, showing the nearness of the final ecdysis; the other two were creamy white in color. The five meconia appeared to be freshly deposited. On the following day, by 9: 30 A. M., a female had emerged and shortly afterwards (9: 52) was observed mating with the male; at 10: 30 A. M., another female emerged. The two remaining pupae died.

Case II. A puparium of *Phormia regina* (Meigen) taken from refuse matter was inclosed in a vial on October 1, after having been carefully broken open in order to ascertain the presence of parasites; six apparently full-grown larvae of the parasite were found within.

On Oct. 28, 1908, it was noted that the larvae remained unchanged; no further note was made until April 28, 1909, when four fully colored pupae and one white one, were found, as well as five meconia, the shriveled remains of a larva of the parasite and the remains of the host pupa. At 10 A. M., April 29, 1 male and 2 females were found recently emerged; by the following day, at the same hour, another female had emerged. The remaining pupa died. All were in natural temperatures.

Case III. In a vial containing 20 puparia and 20 dead larvae of *Phormia regina* — including a single puparium of *Chrysomyia macellaria* — which were obtained from refuse matter late in October, 1908, and thus confined, there were found on April 28, 1909, 11 of the puparia infested with the parasite as follows. All were in natural temperatures.

No	Host	Larvae	White pupae	Black pupae	Adults	Total
1	*Phormia*	2 dead + 1	3	3		9
2	(broken)			1		1
3			2	1		6
4				9	1 ♂, 1 ♀	11
5				8		8
6			1	5		6
7				6		6
8				7		7
9		1		10		11
10		1 dead.	6	8		15
11	*Chrysomyia.*			5	1 ♂.	6

In addition, lying loose in the vial were found 6 dark pupae and 1 recently formed, as well as one adult *regina*. Thus the parasite was found in three stages — nearly all of the larvae had pupated and the adults were just beginning to emerge. On the following day, emergence became general throughout the whole lot and was completed on May 3d, some of the younger white pupae dying. Of the total number of parasites in this case there were more females than males.

The sixty-one larvae recorded in table I, of which 38 were alive and healthy, were evidently hibernating, as the puparia had been in confinement for over a month, and those parasites which matured had long since emerged. A few *Phormia* puparia, infested and isolated on Sept. 15, 1908, contained living, full-grown larvae on Nov. 7, 1908.

M. *Courting and Mating.* Courting in this insect is not a complex habit. It follows almost immediately after emergence, at least in confinement. Where a number of both sexes are gathered together, all recently emerged, the males and females are constantly in motion, the former active, seeking the females, the antennae of both sexes also constantly in motion, held inclined upward in the natural position, giving quick, jerky, wavy movements. When one individual meets another, the antennae simply touch whichever portion of the body presents itself first and the two turn aside and pass on; or if they happen to be individuals of opposite sex and (apparently) the occasion is suitable — which is most often the case immediately following emergence — the male hastily climbs upon the back of the female, runs forward, and grasps her head with the fore feet, usually at the lateral aspect of the eyes or sometimes at the cheeks; the intermediate feet grasp some portion of the thoracic pleura, usually at the mesothorax and the hind feet take hold along the sides of the abdomen or the edges of the flat wings. The legs are not stretched out or used for embracing the body of the female but the hold is taken by the feet alone, and the position of the male is not strained but rather that of the natural position of rest. His body is parallel with and above the body of the female and projects beyond (cephalad) it, so that the head is between the upturned antennae of the female and stretched over hers, his abdomen reaching to a point above the third abdominal segment or to a point opposite to the distal end of the marginal vein of the fore wings upon which it actually rests. Having quickly attained this position, the male senses the antennae of the female with his own and immediately begins suit in earnest by rubbing his head up and down against the inner (mesal) surfaces of the flagella of the female,— which are held upward in a V-shaped position,— at the same time holding the scapes erect and apart and the flagella back, pointing laterad at right-angles to the scape and at every downward movement bringing the scapes together; this movement of the head is accompanied by a corresponding "petting" movement of the female flagella against the cheeks of the male. The up- and downward movements of the head are regular and continued for from 5 to 10 seconds, each completed movement occupying slightly less than a second of time; and they are alternated with a period during which the head of the male is motionless and his antennae sensing those of his mate, either by touching both of their tips to the tips of her antennae, or else by stroking

them up and down, the mandibles, maxillae and labium with both pairs of palpi are themselves in almost constant motion, but so far as observed, they play no part as organs of sensation, with the possible exception of the maxillary palpi. Sometimes, the male rubs but one of the flagella of the female, turning the head to one side. No other movements than these are observable, but there is some variation in the occurrence of either of the two movements described, and also in the number of times they are repeated before sexual union is permitted by the female. The male may be received coldly; he may make the movements without attempting union, or after alternating them three or four times, he may attempt union without success and then run forward to repeat the actions, and this may continue as long as the female permits, either resulting successfully or unsuccessfully. In the presence of other females, if received coldly, the male soon tires, leaves and seeks another mate. In order to attempt union, the male has to reverse his position, and run back to the tip of the abdomen of the female where he usually reaches over the tips of the wings and senses with the antennae, quickly turning and reaching around again with the tip of his abdomen, to gain entrance into the vaginal orifice. Or, on the other hand, he may simply back quickly to the caudal end of the female and attempt union. In one case, previously cited. coition lasted for fourteen seconds; in another, for ten seconds. Mating is promiscuous for both sexes.

The following example may be cited. From a puparium of a host a male emerged during the afternoon of April 28, 1909; by 9:30 A. M. the following day a female had emerged, and shortly afterwards the pair were in ardent courtship; at 9:45 A. M., sexual union occurred, lasting for ten seconds. The male then ran forward again over the back of his mate and rubbed his head up and down her flagella, one of the movements of courtship; he then left. After 30 seconds the male again quickly mounted his mate and repeated the two alternate movements, described in foregoing, continuously for 15 seconds and left for the same length of time. After a minute of attentions he made an unsuccessful attempt to unite with the female, and then left her for some time (12 minutes). Courting was recommenced after this interval of time, continuing for five minutes but with no attempt to unite. Subsequent matings followed during the next 24 hours, though 13 minutes after the last visit of the male, the female had crawled to some host puparia which engaged her attention, and both were less taken with each other.

N. *Effective Parasitism.*

What may be included under this term is an interesting phenomenon in those relations which a parasite sustains to its host. Under natural conditions it may never occur, and here it was observed accidentally. Whether or not a parasite can overcome the effects of development in a host at the time just preceding an ecdysis, when development is liable to be very rapid, is not a very important question, excepting when it is concerned with a host stage of very short duration such as is not present here. *Nasonia*, so far as we know, confines its attacks exclusively to the puparia of its various hosts; this stage is usually of short duration, but not exceptionally short as is the egg stage, so that the period of rapid development immediately preceding the final ecdysis, being short, would not materially prolong the period open to parasitism — that is, the pupal stage — if it in turn were likewise open. The following cases are, therefore, of interest mostly from the scientific standpoint. The host was *Cynomyia cadaverina* in the stage just preceding the final eclosion, though this fact was unknown when the hosts were exposed to the parasites in confinement in order to insure a second generation. The parasites were those from hibernated larvae, or parents of the first generation. The host puparia were formed on April 23, and were thus six or more days old.

Case I. Three virgin females of the parasite emerging at 1:30 P. M., April 29, 1909, were at once confined separately in vials, each with four of the host puparia. Oviposition was not observed. The hosts were then six days old; by 9 A. M., May 1, eight of the host puparia had excluded adults which were at once released; another adult excluded at 11:20 A. M., May 1st, and two more at 8:30 A. M., May 2d; the single remaining puparium was apparently successfully parasitized by one of the females but upon examination on May 15, 1909, no traces of parasites could be found.

Case II. A pair of adults of the parasite which had mated for the first time at 9:45 A. M., April 29, were confined in a vial with eight of the host puparia; the female noticed the hosts at once but left them and was engaged with the male for a short while. During the afternoon, however, she commenced to deposit eggs; at 10:08 P. M., April 30, a host fly emerged and again at 10:25 P. M., the same day, when the mother parasite was engaged in depositing into another host. At 9 A. M., and 7 and 9 P. M., May 1, three host flies emerged, and again on May 2, at 11 A. M., and 5 P. M. The remaining host was

successfully parasitized, it having been partly opened at 3 P. M., May 13 and found to contain larval parasites. In this case the parasite was successful up to within about 24 hours of the final ecdysis, the host pupa being perfect and with all the colors of the mature adult.

Case III. At 11:20 A. M., April 29, nine males and twenty females of the parasite, which had been freely mating, were confined together under a bell-jar with ten of the host puparia; oviposition was observed at noon and was continued with persistence until noon, May 3, when the observations had to be discontinued. During this time none of the hosts emerged, though in a control lot, emergence became general early on May 1, beginning during the morning of April 30. Hence in this case, the parasites being in greater numbers, not a single host escaped.

Summarizing, parasitism by *Nasonia* is "effective" or successful in many cases almost up to within the few hours immediately preceding the final ecdysis, depending on circumstances; a single female parasite, for example, would be able to kill a single host puparium up to within about 15 hours of eclosion, but where a number were present, many would escape before she would be able to deposit into them. And the converse is true. The host when thus attacked is a perfect pupa and fully colored.

O. *Length of Life in Confinement; Adults.*

The adults of this parasite lived for about five days on the average in confinement, the males dying somewhat earlier. They were unfed in all cases.

P. *Change in Coloration of the Pupa.* When first formed the pupae are yellowish white, the eyes garnet, with some duskiness at the caudal edges of the abdominal segments soon afterwards; the mandibles, legs, antennae and wing-pads gradually become dusky and about 48 hours previous to eclosion, the head, thorax and abdomen, in succession, begin to show dark color, the head and thorax together becoming a deep black before the abdomen shows very much color, and then after about 6 hours, the latter turns gradually but rapidly black. About 20 hours before eclosion, the color is jet black, which just preceding emergence changes nearly to the colors of the mature adult. At eclosion, the adults are fully colored.

LITERATURE REFERRED TO.

1878. Thomson, C. G. Hymenoptera Scandinaviae, Lundae, V, pl., fig. 18.
1896. Ashmead, William H., Descriptions of new Parasitic Hymenoptera. Trans. American Ent. Soc., XXIII, p. 221.
1904. Ashmead, William H., Classification of the Chalcid flies or the Superfamily Chalcidoidea. Mem. Carnegie Mus., Pittsburgh, I. (Publications of the Carnegie Museum, Serial No. 21.) pp. xi, 317–318.
1906. Nason, William A., Parasitic Hymenoptera of Algonquin, Illinois.—IV. Entomological News, Philadelphia, May, XVII, p. 221.

THE HARRIS MEMORIAL TABLET.

On Friday, December 31, the final day of the recent entomological meetings in Boston, delegates from the various Societies represented in those meetings went out to Milton village, and with brief ceremony unveiled a simple marble tablet placed on the old "Suffolk Resolves mansion" to commemorate the residence there of Thaddeus William Harris.[1]

The inscription, composed by Colonel Thomas Wentworth Higginson, who in his student days was a pupil of Harris, reads as follows:

IN THIS HOUSE FROM 1824 TO 1831 DWELT
THADDEUS WILLIAM HARRIS M. D.
BOTANIST, ENTOMOLOGIST; AND FINALLY
LIBRARIAN OF HARVARD COLLEGE

IN EACH CAPACITY HE WON
FOR HIMSELF FAME AND GRATITUDE

HE HAD THE MODESTY AND UNSELFISHNESS
OF TRUE SCIENCE
WITH WHAT MAY RIGHTLY BE CALLED
ITS CHIVALRY OF SPIRIT

Besides the entomologists, there were present representatives of the Milton Historical Society and the Science Club of Milton Academy.

W. L. W. FIELD.

[1] See PSYCHE, Vol. xiv. p. 67, August, 1907.

NOTES ON HEMILEUCA LUCINA HY. EDW.[1]

By William Reiff.

On the 19th of last June, while in the company of Dr. Arthur L. Reagh on a collecting trip to the neighborhood of Raymond, N. H., we came upon a swampy meadow where there was an abundance of Meadow-sweet (*Spiraea salicifolia L.*). Immediately my attention was attracted to these plants which harbored a large number of unknown caterpillars. Interested in the find, we looked further and found the same species on nearly every bush of the *Spiraea*. The caterpillars were partly in the second and partly in the third stage, feeding close together in large numbers and dropping to the ground upon being disturbed. They were so thickly distributed on the plants, that often entire twigs were covered with the larvae, giving the impression of strong swellings upon the twigs. According to our estimates, we must have seen more than 20,000 caterpillars in the locality, but owing to lack of proper receptacles, we could unfortunately collect only a small part for breeding.

Although the caterpillars resembled those of *Hemileuca maia* Drury very closely, we could not satisfy ourselves that they belonged to this species, for it seemed strange that all the *maia* females should have laid their eggs on meadow-sweet when there was close by an abundance of oak which is the favorite food of *maia*. We also searched the nearby oaks for *Hemileuca* caterpillars without result, but Dr. Reagh found some *maia* on oaks several miles further on which proved their presence in the locality. Our caterpillars could therefore hardly be *maia*, for this species would have no necessity of laying its eggs on plants other than oaks. As already mentioned, our caterpillars were very similar to those of *maia*, and like them were black in the youngest stage, but distinguishable by a strong brilliancy, best compared to black stove-polish. The appearance of the older caterpillars was exactly like that of *maia*, except that all had a sharply defined white stripe above the feet, which is absent or faint in *maia*. In spite of plentiful and regular feeding the size of the growing caterpillars remained always less than that of *maia*. Pupation occurred on the

[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 13.

surface of the ground under dry leaves, without the preparation of any sort of a cocoon. The cremaster of the pupa is composed of about twenty-five strong brown spines with curved apices (see figure). In other respects, the form and color of the pupa are the same as those of *maia*; the size of *lucina*, however, always remains less. The first moths emerged from their pupae on the 2nd of September, and proved to be two males of *Hemileuca lucina* Hy. Edw. The first females emerged on the 4th of September, and the period of emergence extended almost through the entire month, the last adults appearing on September 28. In all sixty-three moths were obtained, in the proportion of 2:1.3 or about twice as many males as females. No parasites were obtained although six pupae died.

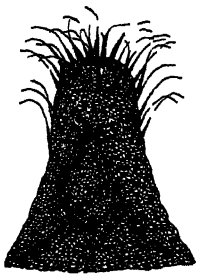


Fig. 1. Cremaster of *Hemileuca lucina* Hy. Edw.

Henry Edwards states in his description of the form *lucina* (Entomologica Americana, Vol. II, No. 1, p. 14, April 1886) that the white band which encloses the discal spot is of equal width across the entire wing. This is not the case, however, as this character is the one which shows the greatest range of variation. I have before me a large number of specimens in which the discal spot is bordered with white only near the fore and hind margins, the white being so much reduced in size that it is divided into two parts by the spot. The most extreme form, of which I have one male and one female specimen, has the white band wedge-shaped and pointed toward the discal spot, above which it shows only as a slight light shadow. Since such extremes of variation in the direction of aberrations undoubtedly deserve names, I propose the name *ab. obsoleta* for this form of *H. lucina* with the following diagnosis:

Ab. **obsoleta** *m.: alis ant. fascia candida plus minusve obsoleta.* Types 1 ♂, 1 ♀, in the collection of the Bussey Institution.

The white band varies in another direction also, and both on the fore as well as on the hind wings. The white band may become cream yellow for its entire extent, the black ground color becoming at the same time changed to a gray, perhaps through some albinistic

tendency. The most typical specimens of this aberration are females, as all the males of this form which I have seen show transitions to the type. I propose the name *ab. lutea* for this yellow form with the following diagnosis:

Ab. **lutea** *m.: alis ant. et post. grisescentibus, fascia lutea nec candida.* Types, two ♂♂ (transitions), two ♀♀, in the collection of the Bussey Institution.

There is also a noteworthy male specimen, which has extraordinarily strongly developed veins, which are of a blackish green-brown color. The veins are irregularly marked with small greenish-brown specks along their entire extent. I am inclined to believe that the pupa from which this specimen developed was supplied with too great a quantity of lymph which enlarged the veins abnormally at the time of emergence, and later penetrated in the form of minute drops through the vein to the surface of the wing.

I treated a small percentage of the fresh pupae (10 specimens) with cold, exposing them to a temperature of –3° C. for seven consecutive days. From these seven moths emerged, three of the pupae dying. Of the emerging moths (6 ♂♂, 1 ♀) the wings of two males did not expand, but the others developed to the normal size. One male was a typical *ab. obsoleta*, the female was the typical *ab. lutea*. The color pattern of the other three males were normal, except that all had the black ground color somewhat lighter than specimens coming from unexposed pupae.

As to the systematic position of *H. lucina*, I cannot but believe that it is a distinct species, and not a subspecies of *H. maia*. The points which would support this position are as follows:

1. There are differences in the caterpillars and pupae of *H. maia* and *H. lucina*.
2. No transitions between *H. maia* and *H. lucina* have been made known.
3. The food plant of *H. maia* (Oak) and of *H. lucina* (Meadow-sweet) are fundamentally different.
4. The habits of the young caterpillars are different. Those of *lucina* are gregarious, forming large clumps on the twigs of the food plant, while those of *maia* sit next to one another, in rows across the leaves.
5. *Maia* pupates under normal conditions in the ground, while *lucina* pupates between dried leaves.

6. I am unable to account for the occurrence at the same place of *H. maia* as typical form with a strongly marked local form. If *maia* and *lucina* are really so closely related, we should expect crosses to take place in nature, especially as when *maia* males first emerge, only females of *lucina* are present, since the flying period of the two species overlaps only in the latter part of September. So far, however, no specimen has been found, which could be a cross between the two, that is to say, one which shows characters of both, for the individuals of both forms are always easily separated from one another. Henry Edwards has already mentioned in his description of *H. lucina* (l. c.) as a very noteworthy fact that all the specimens of *maia* which had come under his observation were readily known as such in spite of their considerable variability, while he was always able quickly to distinguish them from *lucina*.

The species and aberrations of *Hemileuca* occurring in the New England States would therefore be the following:

Hemileuca maia, Drury.
Hemileuca lucina Hy. Edwards.
ab. obsoleta Reiff.
ab. lutea Reiff.

A PECULIAR TYPE OF PHORIDAE FROM NATAL.[1]

By Charles T. Brues.

Until within the last decade, the Phoridae of the Ethiopian region were practically unknown, but during this short period considerable interest in the group has developed among a number of entomologists, and many African forms have been described. Most of these belong to extraordinary apterous types, although several of the less specialized genera have been found in widely scattered parts of the continent. These few discoveries have shown the extreme interest attaching to the Phorid fauna of this region, and I have endeavored to include them in the present short summary, together with the description of an interesting new genus from Natal recently sent to me by Mr. Ernest E. Austen of the British Museum.

Twelve genera are now known to be represented in the Ethiopian region, several of them very closely allied, and probably not actually generically distinct, but all are included in the following table.

Key to the Ethiopian Genera of Phoridae.

1. Wings fully developed.....2
   Wings much reduced in size and venation, or entirely absent.....5
2. Third vein in wing furcate near the tip .....**Aphiochaeta.**
   Third vein simple, not furcate.....3
3. Head of normal form, with sloping front.....4
   Head produced and squarely truncate above the antennae, forming a frontal shield.....**Coryptilomyia.**
4. Anterior frontal setae proclinate, hind tibiae with distinct spurs **Puliciphora**, male.
   Anterior frontal setae absent, hind tibial spurs minute; wings more hairy than usual.....**Chonocephalus**, male.
5. Abdomen of normal form, species often cockroach-like, apical segments terminal in position.....7
   Abdomen greatly swollen, the last segments very small and directed forward under the basal ones.....6
6. Antennal arista pubescent.....**Termitoxenia.**
   Antennal arista loosely plumose.....**Termitomyia.**
7. Wings of considerable size, though much atrophied; no ocelli; proboscis long, geniculate.....**Psyllomyia.**
   Wings very small or entirely absent; proboscis short or wanting.....8

[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 15.

8. Abdomen with distinct segments, indicated by 4–6 dorsal plates or by evident constrictions. 10
   Abdomen with all the segments fused into a single plate or into two . 9
9. Abdomen with two segments, the first short, the second long. **Thaumatoxena.**
   Abdomen entirely unsegmented. . . . . **Termitodeipnus.**
10. Ocelli absent. 11
    Ocelli present. . . . . **Puliciphora.**
11. Abdomen entirely membranous. . . . . **Wandolleckia.**
    Abdomen with chitinous plates. 12
12. Body flattened, oval, cockroach-like. . . . . **Aenigmatistes.**
    Body more convex, with the usual tripartite form. 13
13. Dorsal abdominal plates wide, crossing the entire width of the abdomen. **Chonocephalus.**
    Dorsal plates much reduced in width. . . . . **Cryptopteromyia.**

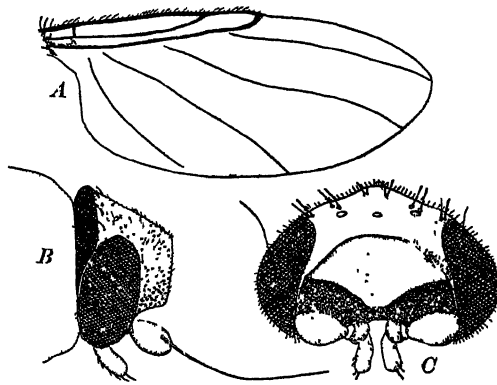
Coryptilomyia gen. nov.

Female. Wings fully developed; costa long, weakly ciliate; third vein simple, bare, neither furcate nor swollen at the apex; first vein long; fourth vein curved parallel to the costa, ending at the wing-tip after a course much nearer the costa than usual; 5th to 7th veins distinct, complete. Head with the vertex prolonged in front, then sharply declivous on the front which bears a raised margin above, giving the front of the head a truncate, shield-shaped appearance. Front without bristles except for an occipital row of four and a similar series of much more delicate ones just anterior to these. Antennae subovate, with dorsal arista. Palpi short, scarcely bristly; proboscis very short, almost rudimentary. Body very robust, the mesonotum broad; scutellum strongly transverse, nearly four times as broad as long. One pair of dorsocentral macrochaetae and six scutellar bristles in addition to one close to each lateral angle on the mesonotum. Legs rather slender, tibiae without macrochaetae, hind ones delicately setulose.

Coryptilomyia armigera sp. nov.

Female. Length 3 mm. Yellowish brown or tinged with castaneous; pleurae and legs fuscous or piceous; abdomen almost entirely piceous, sometimes yellowish medially at the base, the segments with narrow whitish margins. Antennae and palpi bright orange yellow. Head seen from the side less than twice as high as thick, sharp above then concave and sloping down to the upper edge of the frontal shield from which it falls off perpendicularly to the antennal cavities. Eyes large, bare, narrowly oval. Antennae rather large, ovate, with a nearly bare arista as long as the head height. Palpi short and stout, with very delicate bristles below. Ocelli large, ranged in a curved row and well separated. Viewed from the front, the head is about twice as broad as high, the margin of the frontal shield above almost semi-circular in outline, the margin below truncate medially and scalloped out on each side to

conform with the large antennal cavities. Post-ocular cilia very minute. Mesonotum large and broad, considerably wider than the head; at its humeral angles the propleurae extend far inward, so as to be visible from above as large triangular sclerites, each with the prothoracic spiracle near its center. Lateral margins of mesonotum with a fringe of stiff hairs. Mesopleura below the root of the wing with three macrochaetae. Abdomen of the usual form, with none of the segments elongated except the sixth. Legs long and quite slender, the anterior tibiæ entirely bare, each with a microscopic apical spur; middle ones with a fringe of very fine setulae; hind ones with a row of rather strong



Coryptilomyia armigera sp. nov. Female.

A. Wing; *B*. Side view of head; *C*. Front view of head.

setulae along the dorsal edge, and a second one along the outer side; all four posterior tibiae with distinct spurs. Wings of ample size, hyaline with fuscous veins; the costal vein reaching to the middle, its cilia very short; tip of first vein twice as far from the humeral cross-vein as from the tip of the third; fourth vein running nearly parallel to the wing margin, forming a very narrow cell and ending barely before the wing tip; fifth sinuous, curving forward on its apical half; sixth nearly straight; seventh curved, close to the wing margin. Halteres dark brown.

Two specimens from Durban, Natal, South Africa, 1909. (B. Marley.) Type in the British Museum of Natural History.

Phora cochleariPalpus Speiser.

Berliner entom. Zeitschr., 52, p. 146. (1908.) Amani, German East Africa.

Aphiochaeta braunsi Brues.
Entomological News, 1907, p. 391. Cape Colony.

Aphiochaeta xanthina Speiser.
Berliner entom. Zeitschr., 52, p. 148. (1908.) Kamerun.

Psyllomyia testacea Loew.
Wiener entom. Monatsschr., 1, p. 51. (1857.) Cape Colony.

Puliciphora africana Brues.
Ann. Mus. Nat. Hungarici, 5, p. 410. (1907.) German East Africa.

Chonocephalus kiboshoensis Brues.
Ann. Mus. Nat. Hungarici, 5, p. 410. (1907.) German East Africa.

Wandolleckia cooki Brues.
Trans. American Entom. Soc., 29, p. 392. (1904.) Liberia.

Wandolleckia indomita Brues.
Ann. Mus. Nat. Hungarici, 5, p. 412. (1907.) German East Africa.

Cryptopteromyia jeanssoni Trägårdh.
Zool. Jahrb. Atbh. f. Syst., 28, p. 229. (1909.) Natal.

Aenigmatistes africanus Shelford.
Journ. Linn. Soc. London, Zool., 30, p. 151. (1908.) Victoria Nyanza.

Thaumatoxena wasmanni Breddin & Börner.
SB. Gesellsch. naturf. Freunde Berlin, 1904, p. 87. Natal.

Termitodeipnus andreinii Silvestri.
Redia, 3, p. 356. (1906.) Eritrea.

Termitoxenia havilandi Wasmann.
Zeitschr. wiss. Zool., 67, p. 601. (1901.) Natal.

Termitoxenia jaegerskioeldi Wasmann.
Results Swedish Exped. Egypt & White Nile, 13, p. 16. (1901.) Uganda.

Termitomyia braunsi Wasmann.
Zeitschr, wiss. Zool., 67, p. 611. (1901.) Orange Free State.

Termitomyia mirabilis Wasmann.
Zeitschr. wiss. Zool., 67, p. 610. (1901.) Natal.

Phora camariana Coquerel.
Ann. Soc. Ent. France, 6, p. 189. (1848.) Madagascar. This is not recognizable from the description and may quite probably not belong to this genus.

RECENT LITERATURE.

INDIAN INSECT LIFE. By H. Maxwell-Lefroy, Entomologist, Imperial Department of Agriculture for India, Assisted by F. M. Howlett. Thacker, Spink & Co., Calcutta & Simla. 1909.

Although this book was primarily intended for the struggling student of entomology in India, it contains much of interest and value to workers throughout the World and American entomologists will find it worthy of a careful reading. Nearly 800 pages, 84 plates principally in color, and 536 figures compose the volume of goodly royal octavo size which is very well printed.

The subject matter treats specifically of the insects of the "Plains" or tropical India, an area embracing all the southern part of India except on mountains rising above 2000 feet, which contour line also limits it on the north in the foot-hills of the Himalayas from subtropical India which is not dealt with in the present work. It appears that insects are much less numerous in tropical than in subtropical India, due to the absence of the moist forested slopes and varied types of vegetation which occur on the hills of the latter.

Throughout the volume special stress is laid upon economically important insects many of which are close counterparts of related species known to western entomologists and numerous species are discussed which will quite probably enter our own country in the future. Among these are particularly various forms destructive to rice, cotton, corn, cane, tea, etc. A very commendable feature is the illustration of the complete life history of many species.

Interspersed among the systematic enumeration of families with their more prominent Indian representatives, are short discussions of topics of more general biological interest, making on the whole a very readable book in spite of its large size and necessarily taxonomic character. The author is certainly to be admired by his more fortunate American co-workers for having presented in very well arranged form a summary of the entomology of a country like India where the entomologist must still be a pioneer in his chosen field.

C. T. B.

FIFTH MEETING OF THE ENTOMOLOGICAL SOCIETY OF AMERICA.

The Fifth Meeting of the Entomological Society of America was held at the Harvard Medical School, Boston, Dec. 30th and 31st, 1909. The President, Dr. Henry Skinner, presided throughout the sessions. The President announced the deaths of William H. Edwards, an Honorary Fellow, Prof. Mark Vernon Slingerland, a Fellow, B. H. Guilbeau, W. Brodie and H. M. S. Seib, Members. Suitable resolutions on the deaths of Mr. Edwards and Professor Slingerland were adopted. The Report of the Executive Committee showed among other things that 16 new members had been received during the year and 22 memberships had terminated, not including those who had died. Also that a memorial drawn up by Mr. N. C. Wood regarding the tariff on insects and signed by the President and Secretary had been productive of no action by Congress.

The question of appointing delegates to the approaching International Congress of Entomology was referred to the Executive Committee.

The following officers were elected:

President, Dr. John B. Smith.
First Vice-Pres., Dr. S. A. Forbes.
Second Vice-Pres., Prof. V. L. Kellogg.
Secretary-Treasurer, Mr. C. R. Crosby.

Additional Members of the Executive Committee.

Prof. J. H. Comstock
Prof. W. M. Wheeler
Mr. E. A. Schwarz
Prof. J. M. Aldrich
Rev. Prof. C. J. S. Bethune
Prof. Lawrence Bruner.

Member of the Committee on Nomenclature.

Prof. T. D. A. Cockerell (to succeed himself).

The Report of the Committee on Nomenclature concerning the nomenclature of Gall Insects read at the Baltimore meeting, and printed in the Annals for 1909, was adopted as printed, with the provision that the Society express itself as standing with the majority of the Committee in Section V.

Mr. Brues suggested that Professor Felt submit a list of names of Gall Insects that he thought could be accepted as standard.

Moved and carried that the request of Dr. Stiles published in Science, for the preparation of a list of one hundred important names to be adopted by the Congress of Zoology as standard, be referred to the Executive Committee.

The following amendment to the Constitution was adopted:

Article V., Sec. 3. Election of officers. All officers shall be elected by ballot at the annual meeting for the term of one year and shall be eligible for re-election. Their term of office shall commence with the first of June following their election.

The Secretary was instructed to take a mail vote of all members and fellows of the Society as to whether the present arrangement of paying separate dues and subscriptions to the Annals should be continued, or a single membership fee of two dollars be charged, and members receive without further expense the publications of the Society.

Professor Sanderson suggested the adoption of a uniform style of button for both the entomological societies meeting in affiliation with the American Association for the Advancement of Science. Referred to the officers.

The following papers were read during the sessions:

R. Matheson. Remarks on the External Anatomy of the Haliplidae.

W. M. Wheeler. On the Effects of Parasitic and Other Kinds of Castration in Insects.

A. H. Morgan. Some Correlations of May-fly Structure and Habits.

C. R. Crosby. Some Observations by the Late Professor Slingerland and the Speaker on the Life History of *Heterocordylus malinus* (Read by title.)

C. J. Triggerson. The Life-cycle of the Oak Hedge-hog Gall-fly (*Acraspis erinacea*).

F. L. Washburn. A Jumping Seed-gall on the Burr Oak.

A. D. MacGillivray. The Female Reproductive Organs of *Corydalis cornuta*.

W. L. W. Field. The Offspring of a Captured Female of *Basilarchia proserpina*.

H. H. Lyman. An Improved Drawer for Insect Cabinets and a New Substance for Lining them.

C. T. Brues. Some Notes on the Geological History of the Parasitic Hymenoptera.

J. C. Bradley. The Plaiting of the Wings of Hymenoptera.

T. J. Headlee. An Apparatus for the Determination of Optimums of Temperature and Moisture for Insects.

A. D. MacGillivray. The Radial Sector in *Phlebatrophia mathesoni*.

W. T. M. Forbes. A Structural Study of some Caterpillars.

M. J. Elrod. The Blackfoot Glacier as an Entomological Burying Place. (Read by title only.)

J. J. Davis. *Chaitophorus populifoliae* Fitch versus *Chaitophorus populifoliae* Oestland. (Read by title only.)

L. Haseman. The Life History of a Species of Psychodidae. (Read by title only.)

A. G. Hammar. Notes on the Life history of *Fidiobia flavipes* Ashmead, an Egg Parasite of the Grape Root Worm (*Fidia viticida* Walsh).

A very interesting and extensive exhibition was held in conjunction with and under the auspices of the Cambridge Entomological Club in rooms adjoining the meeting hall.

The Annual Public Address was given by Dr. John B. Smith on the evening of December 30 in the hall of the Boston Society of Natural History, title: "Insects and Entomologists: Their relations to the Community at Large."

On Tuesday evening the visiting entomologists were the guests of the Cambridge Entomological Club at a most enjoyable smoker held in Copley Hall.

J. Chester Bradley,
Secretary-Treasurer.

PSYCHE

VOL. XVII. APRIL, 1910.

THE GENUS TACHYDROMIA.[1]

By A. L. Melander, Pullman, Wash.

Concerning the application of the generic names *Coryneta*, *Tachydromia*, *Platypalpus*, *Tachypeza* and *Tachista* of the family Empididae there is much confusion. In his early paper, the Nouvelle classification des mouches à deux ailes, bearing the date 1800, Meigen gives his forty-fourth genus the name *Coryneta*, describing it as follows. "Antennes à deux articulations: la première petite, hérissée de poils; la seconde conique, terminée par un poil barbu. Trompe perpendiculaire. Cuisses des jambes du milieu enflées. Le tibia armé a l'extrêmité d'un piquant. Les ailes croisées."

No species of the genus are mentioned by name, but Meigen states that he has recognized three species. In 1803 in his revision of this paper in Illiger's Magazine, Meigen gave the name *Tachydromia* to the fifty-second genus, mentioning however this time two species, *cursitans* Fabricius and *cimicoides* Fabricius. His diagnosis of *Tachydromia* is as follows. "Die Fühlerhörner vorgestrekkt, zweigliederig: das erste Glied becherförmig; das zweite kegel-förmig in eine Borste auslaufend. Der Rüssel senk-recht. Schenkel der Mittelfüsse dikk, stachlig. Die Flügel flach parallel."

It will be noted that the two descriptions read much alike, which is why Bezzi (in lit.) and Hendel[2] have concluded that both refer to the same genus, and that therefore the older name *Coryneta* should be given preference. The Nouvelle Classification has been an extremely rare paper. But three copies are known to exist, one at the Academy of Natural Sciences, Philadelphia, a second owned by Professor Heyden, and another belonging to the late Osten Sacken, and now in the possession of Dr. Hendel. Because of the obscureness of this early paper of Meigen it has been neglected by all writers. Its names are not given in the nomenclators, and even Meigen himself ignored its

[1] Contribution from the Zoological Laboratory of the State College of Washington.
[2] Verhandl. k. k. zool.-bot. Gesellsch., Wien, 1908. pp. 43–60.

existence in his later works, as if ashamed of the curious meaningless names of his first publication. The diagnoses are brief, general and ambiguous, and, since no species are mentioned the identity of the genera would have remained mostly unknown, were it not that some of the early descriptions bear a similarity to the corresponding ones of the later paper. In nearly all cases however the generic names of 1800 are entirely different from those Meigen later used. The genera of Meigen's second contribution are well known, as for most of them typical species were cited at the beginning, and their names have been in constant usage for our commonest flies for more than a century. Even by this method of comparison and elimination many of the 1800 genera will never be understood.

This early publication of Meigen remained entirely ignored until Dr. F. Hendel republished it entirely in the Verhandlungen of the Wiener Gesellschaft. If we were to accept his guesses as to the identity of these early genera we would overthrow such well-known names as *Ceratopogon*, *Odontomyia*, *Eristalis*, etc., as well as the long established type-genera of over a dozen families of diptera. But much of his evidence is insecure. The paper is worthless if not interpreted by Meigen's later works, the date of publication cannot be verified, there is even doubt if the paper was distributed on the date it bears, and nowhere are any species cited, so the genera are not true binomial conceptions. This last condition alone should not be followed too closely, for many of Meigen's genera of 1803 and 1804 were likewise published without mention of species.

Naturally to exhume these forgotten names has stirred up much discussion, and in the short interim since Hendel's republishing, there have been a score of opinions given out by various biologists. These opinions are sometimes conflicting but in the main zoologists strongly decry using the law of priority to bolster up such speciesless genera as Meigen's earliest. I shall give a list of the articles that have come to my notice bearing directly or indirectly on the principle of whether or not to adopt the newly disinterred genera. In this long parley the concrete example of Meigen's paper has been lost sight of by many of the contributors, and merely the principle has been under discussion, but nevertheless the entire argument outlined below was caused by the appearance of Hendel's reprint. A short digest of the articles will help to correlate the ideas advanced.

Professor Aldrich wrote in hopes of squelching Hendel's paper, to

deter others from using the ancient names. Yet Kertész' last volume of the Catalogus Dipterorum hujusque descriptorum, volume v., 1909, adopts the family name Omphralidae for the Scenopinidae; his Catalogue of palaearctic diptera uses five of the early names in volume iii; while *Czerny* in a paper on Spanish Diptera [1] has discarded the family names Scatophagidae and Trypetidae, as he uses for them Meigen's earlier type genera *Scopeuma* and *Euribia*, forming thereby the family names Scopeumatidae and Euribiidae. However, Czerny does not use Meigen's early *Cypsela* to replace *Borborus*, as was advocated in Hendel's reprint.

Volume iii of the palaearctic catalogue has dispensed with the following well known genera on the plea of priority: *Ephippium*, *Oxycera*, *Odontomyia*, *Xylophagus*, *Haematopota*, *Subula* and *Leptis*. Surely the dipterist has a bewildering memory-lesson before him.

It is strongly to be urged in this period of nomenclatural unrest that writers be not too hasty in adopting the suggestions of Dr. Hendel. The trend of public opinion is that genera without species shall have no place in our system of classification. In view of the projected action of the Committee of the International Congress of Zoologists (see number 23 below), it would be decidedly rash to rush into publications the once-discarded names of 1800. It would be better to hold in abeyance any personal desires for Meigen's first names until the Committee can rectify the Code on this question. Such conservatism may prevent a premature overthrow of the names of our commonest genera, and might spare our overburdened literature from most confusing rearrangements of synonyms.

1. Nature, August 27, 1908, pp. 394-395.
   A composite letter by British zoologists deploring the fact that a strict adherence to rules sometimes brings unfortunate consequences.
2. N. Banks, Science, xxviii.
   Advises others who have rare papers to republish them.
3. S. W. Williston, Manual, 3rd. edit. p. 390, 1908.
   "Hendel would have deserved the thanks of a long suffering public had he withheld these copies instead of republishing."
4. M. Bezzi, Wiener entom. Zeit. xxvii. 252, Sept. 1908.
   Comments on the adoption of the names of 1800 that come in vol. iii. of Kertesz' Catalogue of palaearctic diptera, a course in which, naturally, he approves.

[1] Verh. k. k. zool.-bot. Gesellsch., Wien, vol. 59, 1909.

5. J. M. Aldrich, Canad. Ent. xl. 370 373. Oct. 1908.
   Compares resurrecting the 1800 paper to finding some old grant to Indian lands. Every possible objection should be made before accepting them; a flawless case must be made out and the identification of the older genera is full of flaws. "Let justice be done" exclaims Hendel. To whom? Certainly not to Meigen by accepting this paper.
6. J. M. Aldrich, Canad. Ent. xl. 132, Nov. 1908.
   Quotes from Bezzi's paper (number 1, above) in the Wiener entomologische Zeitung. Hendel (number 9, below) says that the quotation is mis-applied.
7. D. W. Coquillett, Canad. Ent. xl. 157, Dec. 1908.
   Pleads for the adoption of the early names, citing rules from the code to cover his argument. Does not believe in obstructing the progress of nomenclature by discrediting Hendel's find.
8. P. H. Verrall, British Flies, v. 772, 1909.
   Meigen's 1800 genera are not legally established. Does not concur with Coquillett's "aggravated" pleading (no. 7).
9. F. Hendel, Wiener entom. Zeit. xxviii. 33-36, Feb. 1909.
   Discusses the comments in numbers 3, 4, 5, 6, 7, and 8. Stability of nomenclature can be had only by a strict adherence to the law of priority. Since Meigen described only genera, but gave the number of species that he knew, and in the preface designated his work as a prodromus of a later work designed to contain only the genera, he can not be said to have carelessly neglected the principles of binary nomenclature. Hendel states that 39 of the Brachycera genera can be immediately recognized from the descriptions alone. The future alone can tell whether the majority of dipterists will decide for continuity or for priority.
10. T. D. A. Cockerell, Science, xxix. 339, Feb. 26, 1909.
    Calls for a postal vote of opinions about genera without species. "A genus without species has no type, no content, and apparently has no place in our systems of classification."
11. J. M. Aldrich, Canad. Ent. xli. 103, March, 1909.
    In a review of Verrall's British Flies, Aldrich quotes the discovery of certain Chicago historians that the annulment of one of the marriages of King Henry VIII. was invalid, and that, consequently, King Edward VII. is not King of England. This discovery is on a par with the reasoning that Meigen's earliest genera should claim priority.
12. T. D. A. Cockerell, Science, xxix. 813, May 21, 1909.
    The result of the postal vote (number 10) shows the majority of voters not in favor of resurrecting the names of speciesless genera.
13. A. A. Girault, Science, xxix. 814, May 21, 1909.
    A genus described without a species is non-existent. Its name has no status until some definite type species has been designated.
14. J. A. Allen, Science, xxix. 935, June 11, 1909.
    "Prior to 1810 hundreds of genera now in current use were proposed solely on the basis of a diagnosis; although they were accepted and

have been in use from the date of their proposal, many of them were without designated types for half a century." "Apparently each case should be dealt with solely on its own merits."

15. F. N. Balch, Science, xxix. 998, June 25, 1909.
In a paper, "A Lawyer on the Nomenclature Question" Mr. Balch advocates an International Court with absolute power to settle everything nomenclatorial. The priority rule was not intended to be the superstition and incubus it has become. "Questions of nomenclature are of utterly insignificant importance so only that they be settled one way or the other, quickly, definitely, and permanently."

16. F. A. Bather, Ann. Mag. Nat. Hist. (8) iv. 37–42, July, 1909.
In an article "Some Common Crinoid Names and the Fixation of Nomenclature," Dr. Bather advocates the establishment of a court of nomenclature.

17. Wm. H. Dall, Science, xxx. 149, July 30, 1909.
Most questions of nomenclature can be answered by a serious study of the Code. For the few other cases he advocates giving the Committee power of decision.

18. A. N. Caudell, Science, xxx. 210, August 13, 1909.
"How can we get a type for a genus where there were no species originally included?"

19. F. A. Bather, Science, xxx. 311, Sept. 10, 1909.
Advocates a Court for the two cases, first, where the application of the Code is obscure, and second, where its application is clear, but the consequences at the same time would be exceedingly unfortunate.

20. J. A. Allen, Science, xxx. 365, Sept. 17, 1909.
"The only point is whether they are good genera or bad genera — in other words whether they are identifiable or unidentifiable from the basis furnished by the original founder."

21. J. Dwight, Jr. Science, xxx. 526, Oct. 15, 1909.
"Zoological nomenclature to-day seems to be little more than an intricate game of names, fascinating sport for its faithful devotees, but an intolerable nuisance for the uninitiated many." "Priority is rather a bog from which the nomenclatorial muck-rakers exhume the fossil remains of a past age." "It is not justice for the dead zoologist that we need so much as justice for the living, and even now the dead get no recognition if they violate the rules of a game unknown in their day."

22. A. S. Hitchcock, Science, xxx. 597, Oct. 29, 1909.
Believes it impractical for a committee to prepare a list of names that will be stable, because of the changing state of biological knowledge.

23. J. A. Allen, Science, xxx. 596, October 29, 1909.
Proposes the following recommendation for the International Committee. "A generic name proposed without mention of any described species is invalid unless it is accompanied by a diagnosis of such a character as to indicate that it is based on a previously known species, or group of species, that can be unequivocally identified as the basis of the diagnosis."

Therefore, instead of worrying over just which of the genera can be identified, it will be vastly better for the present to ignore entirely the Nouvelle Classification. It is absurd rigidly to apply modern rules of nomenclature to the works of the early writers, when as in this instance no good can be subserved, and a most confusing and "complete revolution in dipterological nomenclature" would result, a condition that Dr. Hendel seems eagerly to have hoped for. It is commendable to make use of the law of priority when stability and permanence will be guaranteed, but in the present case it is too risky to accept Dr. Hendel's views and make the wholesale changes he has suggested. Dr. Stiles has remarked that "neither the commission nor the congress has any power to force zoologists and others to accept the International Rules." I believe that my dipterist fellow workers should feel that one such occasion confronts them, if rules are to be construed, or misconstrued, to bolster up the once-discarded names.

With this digression we may disregard the name *Coryneta,* and take up the name *Tachydromia.* As just mentioned, Meigen assigned *Musca cursitans* Fabricius and *cimicoides* Fabricius to his genus. The first of these was an erroneous determination which was afterwards named *major* by Zetterstedt. *Cimicoides* Fabricius is a synonym of *arrogans* Linneus, but Meigen was confused in his identification here too, as a part of the specimens he thought were *cimicoides* he afterward described as *connexa.* Meigen had therefore three species before him, of which two were undescribed, and the third had previously been named *arrogans* by Linneus. Obviously, according to modern rulings, the type of *Tachydromia* must be selected from these three, and as *arrogans* was the only described species among Meigen's material, that species would probably be construed as the type. But neither *arrogans* nor *connexa* has the middle femora enlarged, nor are their middle tibiae spurred. Therefore they disagree with the only salient point of the diagnosis. For that reason, according to our present ideas, neither would have been selected as the type, and the honor of serving as type of *Tachydromia* should have been bestowed on Meigen's *cursitans* (*major* Zett.). The old genus has been dismembered, the separated genera have received their types, and our present ideals have not been fulfilled, because of the everlasting blundering between personal whims and priority laws.

Article 30 of the Code states: "If the original type of a genus was not indicated, the author who first subdivides the genus may apply the

name of the original genus to such restricted genus or subgenus as may be judged advisable, and such assignment is not subject to subsequent change." Dr. Stiles [1] has given a personal ruling further that "If an author, in publishing a genus with more than one valid species, fails to designate or to indicate its type, any subsequent author may select the type, and such designation is not subject to change." Although this is a personal opinion its soundness is apparent. With these citations, we may take up the subsequent history of Meigen's *Tachydromia.*

Meigen's early conception of the genus was the same as our present idea of the subfamily Tachydromiinae, or even the combined subfamilies Tachydromiinae and Hemerodromiinae, and in this he was followed by the earlier writers, such as Fallén. In 1822 in the third volume of the Systematische Beschreibungen Meigen separated from *Tachydromia* the genera *Hemerodromia* and *Drapetis.* The remaining Tachydromias he grouped into two divisions, A and B, with his *cimicoides* in A. and his *cursitans* in B, but still retaining all in the genus *Tachydromia.* Macquart in 1827 bestowed the name *Platypalpus* on division B which was the larger group, keeping the name *Tachydromia* for the first group, but Meigen not knowing this renamed the first division *Tachypeza,* to retain the original name for the larger division. This change was published in 1830, and later he refused to adopt Macquart's name because he thought his own ideas were better.

In a paper in the Zeitschrift fuer Entomologie, published in Breslau in 1863 Loew discussed the question at length and following Meigen discarded the name *Platypalpus* because it is a poorly formed compound of Greek and Latin. For the larger group, or those species related to *cursitans,* he retained the name *Tachydromia.* The remainder of the genus he subdivided into *Tachypeza, Tachista, Dysaletria,* and *Phoneutisca,* bestowing the name *Tachista* on those species grouped about *cimicoides.* The majority of the prominent European dipterists have adopted this view principally out of deference to Meigen and Loew.

The date of publication of the name *Platypalpus* is certain, and its designation is unquestionable. We have therefore no recourse but to accept it as a valid name. To this genus belongs the *cursitans* of Meigen's original *Tachydromia.* Eliminating this species, the *cimi-*

[1] Bull. 24, Hygienic Laboratory, p. 27 (1905) Rule 10.

coides of Meigen should be the type of the restricted *Tachydromia*. Coquillett however has designated *connexa* as the type, forgetting that part of Meigen's *cimicoides* belonged to Linnaeus' early species *arrogans*. This however will not invalidate the limitations of the restricted Tachydromia, as *arrogans* and *connexa* are very closely related species, certainly congeneric.

The status of the old genus *Tachydromia* is therefore as follows.

Front and middle femora thickened: *Division B.* Meigen.
Platypalpus Macquart, Westwood, Blanchard, Walker, Schiner, Philippi, Coquillett, Melander.
Tachydromia Meigen, Burmeister, Zetterstedt, Berendt, Scholtz, Bonsdorff, Loew, Bigot, Mik, Strobl, Becker, Kertész, Bezzi, Frey.
Phoroxypha Rondani, Coquillett.
Front femora thickened: *Division A.* Meigen.
Anal cell imperfect..... **Tachypeza** Meigen, Loew.
Anal cell completely wanting..... **Tachydromia** Meigen, Coquillett.
Tachista Loew, Becker.

The type species of these genera are as follows:

Platypalpus. Type species *cursitans* Fabricius, indicated by Westwood in 1840. It is quite likely that Westwood had Meigen's original *cursitans* in view, in which case the type should be *major* Zetterstedt.

Tachypeza. Type species *nubila* Meigen. Rondani in 1856 designated *nervosa* Meigen as the type, and this is a synonym of *nubila*.

Tachydromia. Type species *connexa* Meigen. As explained before Meigen indicated two species, *cursitans* and *cimicoides*. As the type species should be one of those originally listed by the describer elimination leaves *cimicoides* as the type, since Meigen's *cursitans* belongs to the subsequently erected genus *Platypalpus*. Meigen's *cimicoides* included two species, *arrogans* Linnaeus and the later described *connexa* Meigen, the second of which Mr. Coquillett has designated as the type.

During the last half century a number of other genera have been proposed for new material rather than as constrictions of the older genus. The relationships of these genera can be seen from the following synopsis of the present subfamily Tachydromiinae. All the known genera and sub-genera are included.

Genera and Subgenera of the Tachydromiinæ.

Thorax slender, humeri large, strongly constricted: palpi narrow: legs not bristly: front femora thickest.

First basal cell much shorter than the second: black species.

Anal cell present: arista terminal..... .....**Tachypeza** Meigen.

Anal cell completely wanting.

Arista terminal or sub-terminal: marginal cell long.

Tachydromia Meigen.

Arista sub-dorsal: second vein abruptly recurved.

Phoneutisca Loew.

First basal cell longer than second; outer angle only of anal cell present: yellow species.... .. ..**Dysaletria** Loew.

Thorax broad: humeri rately large: legs hairy and usually with bristles: palpi usually broad.

First basal cell shorter than second: eyes close together, especially below the antennae.

Arista terminal.

Anal cell complete or incompletely formed.

Front and middle femora thickened: middle femora with a double row of spines beneath: middle tibiae ending in a spur: eyes separated: palpi broad.....**Platypalpus** Macquart.

Last joint of tarsi normal..... .....**Platypalpus** s. str.

Last joint of anterior tarsi greatly lengthened.

Cleptodromia Corti.

Femora not thickened: middle legs without spurs and with minute or no spines: eyes contiguous: palpi small: basal cells subequal.

Symballophthalmus Becker.

Anal cell wholly wanting: posterior femora more or less thickened.

Drapetis Meigen.

Body robust, abdomen shorter than thorax: Wings broad, not ciliate.

Third antennal joint short-oval.....**Drapetis** s. str.

Third antennal joint lanceolate.. .....**Elaphropeza** Macquart.

Body more slender: abdomen longer than thorax: wings cuneiform: costa long ciliate.....**Ctenodrapetis** Bezzi.

Arista dorsal: front femora thickened.....**Stilpon** Loew.

First basal cell equal to or longer than second: more or less opaque pollinose species: eyes usually widely separated on the face.

Arista dorsal.

Wings less than one-third the abdomen.....**Thinodromia** Melander.

Wings surpassing the abdomen, anal cell faint...**Halsanalotes** Becker.

Arista terminal.

Antennae three-jointed: legs thick and bristly: eyes very small.

Coloboneura Melander.

Antennae two-jointed: legs but little thickened and with few bristles, face narrow.....**Chersodromia** Walker.

Tachydromia sens. str.

Minute, slender flies of shining jet-black color and almost devoid of hairs and bristles. Head globular, eyes large, with large facets, in both sexes broadly contiguous on the face; front narrow, its sides nearly parallel, and but slightly diverging toward the vertex; three ocelli present; occiput broad, produced sub-conically at the neck and provided with sparse short bristles. Antennae short, two-jointed, the outer joint short rounded oval, with the long slender nearly bare arista terminal or nearly so. Proboscis shorter than the head, rigid, vertical: palpi applied against the proboscis and tipped with several short bristles.

Thorax longer than broad, not greatly convex, not truncate in front but considerably narrowed from the wings forward; humeri remarkably enlarged and separated from the narrow central part of the mesonotum by more or less deep furrows; a prealar lateral bristle on mesonotum; scutellum normally with two pairs of short marginal bristles, the basal pair microscopic, usually no other thoracic bristles or hairs present. Hypopygium small, more or less globular, or triangular in outline, terminal. Legs slender, the front femora somewhat thickened, devoid of bristles, but with microscopic hairs, those of the under side of the front tibiae serrately arranged, no spurs or conspicuous spines present. Sometimes the male legs have small spines on the middle femora or tibiae beneath. Wings narrow, costa ending at the fourth vein and sometimes thickened beyond the insertion of the first vein, hind margin of the wing short ciliate; no trace of an anal cell present.

Our known American species of *Tachydromia* divide nicely into two groups. The first of these includes slender species with elongate wings and legs. This group is typical of *Tachydromia* and is largely represented in the palaearctic fauna. The second group is more aberrant. Our species will probably be separated ultimately from *Tachydromia* as several genera, but for the present it would be quite unwise to do so. It is unfortunate that the small size and difficulty of capture of these species are responsible for their scarcity in collections. Undoubtedly we know but a fraction of the forms the world over, and until our collections are more complete we cannot hope to understand the relationships of these interesting little flies.

The typical Tachydromias are shining black, nearly bristleless flies and have a dark band, or two dark bands, across the wings. The

arista is terminal and the palpi are long and narrow. The front of the head is very narrow, its sides almost parallel. The emargination of the eyes at the level of the antennae is less deep, and all the facets are of nearly uniform size. The pectus is pruinose, the coating extending backwards to form a conspicuous glistening white spot over the front coxae and under the humeri. The hypopygium is also somewhat smaller than with the other members of the genus. The first basal cell is generally very long. It is to this group that *arrogans* and *connexa* belong.

The species of the second group differ in having a shorter and broader thorax, with the humeri not so pronounced. They lack the pruinosity above the front coxae. The arista is subterminal and the palpi are usually broader. The front of the head is broader, with its sides diverging above. The eyes are more deeply emarginate, and the lower facets are conspicuously larger than the upper. The wings are shorter in proportion to the body, and are not fasciate; the two basal cells are more nearly equal in size, and the marginal cell is usually shorter.

Although the genus separates into two definite groups whose characters may seem to be of generic value, I hesitate about placing together the species of group two as a restricted genus, for they appear to represent several phyletic lines. The basic points of difference between these species are the following:

1. *simplicior*. Wings as in *Drapetis*: palpi narrow: thorax glistening, devoid of bristles: humeri prominent.
2. *maculipennis, calva*. Palpi narrow: thorax narrow, glistening black, devoid of bristles, humeri prominent.
3. *insularis*. Thorax shorter, somewhat glaucous, humeri smaller: palpi long and narrow.
4. *agens, universalis*. Thorax somewhat glaucous, shorter, with bristles; humeri smaller: palpi broader.

The table following is given for the determination of the American species. Several other species have been referred to this genus by one writer or another. The accompanying notes will explain their status.

Tachydromia lata Coquillett [1] is omitted from the tables as it probably is a *Drapetis*. Since the description states that the mesonotum is broader than long, the legs are provided with bristles and the first

[1] Proc. Ent. Soc. Wash. V. p. 266 (1903).

basal cell is much shorter than the second it is evident that the species is not a *Tachydromia*. Mr. Coquillett separates *Tachista* (or *Tachydromia* as here given) from *Drapetis* in his analytic key only by the comparative thickness of the front femora, an elusive characteristic.

Tachydromia nubifera Coquillett [1] has been referred by its author [2] to the genus *Coloboneura*, a genus which has very bristly legs. I am unable to corroborate this from his description alone. The shortened second basal cell of *nubifera* excludes the species from *Tachydromia*, but the subopaque pruinosity and colored wings are at variance with the typical species of *Coloboneura*.

Mr. Coquillett has assigned *Drapetis flavida* Williston to *Tachista* [3] While the male is unusually slender for a typical *Drapetis* this species lacks the constricted swollen humeri of the *Tachydromia* group and moreover the legs are pubescent and provided with bristles and both the marginal and the first basal cells are short as in *Drapetis*. The species can with all propriety be located in Bezzi's recent subgenus *Ctenodropetis*. It may be here noted that the description of *Tachydromia bacis* Walker described from Jamaica tallies with this species. As Mr. Walker's description is unusually complete, mentioning even the bristles of the legs, it is reasonably certain that both species are the same. I have specimens from Yucatan, Orizaba, Vera Cruz, Cuba and Hayti. Mr. Coquillett reports it from Porto Rico, and Dr. Williston's specimens came from St. Vincent. It is evidently a common species within its geographic range. There is an ancient and brief description of *Tachydromia abdominalis* Wiedemann [4] from China that also applies to our specimens. *Ctenodrapetis ciliatocosta* Bezzi [5] from Australia is also quite similar, but is somewhat smaller. Possibly there is but one widely distributed form. I take it that *abdominalis* is a *Ctenodrapetis* rather than a *Platypalpus* as the abdomen is described as lusterless. In almost all the species of *Platypalpus* the abdomen is shining.

Mr. Coquillett [6] thinks that *Phoneutisca bimaculata* Loew is a synonym of *maculipennis* Walker which was described from Hudson

[1] Dipt. Commander Isl. p. 343 (1898).
[2] Proc. Ent. Soc. Wash V. p. 265 (1903).
[3] Proc. U. S Nat. Mus. XXII. p. 251 (1900).
Proc. Ent. Soc. Wash. V. p. 265, note. (1903.)
[4] Auss. zweifl. Ins. II. 12 (1829).
[5] Ann. Mus. Nat. Hung. II. p. 355 (1904).
[6] Proc. Ent. Soc. Wash. V. p. 266 (1903).

Bay Territory. I do not think this is so. *Bimaculata* is a much smaller species with white palpi, and is rare. The only specimen I have seen is the type from Alaska. I take it however that *maculipennis* is the same as our common *pusilla* Loew. I have examined over fifty specimens of this species from Massachusetts, Wisconsin, Illinois, Missouri, and South Dakota. Since it is so widely distributed in the States it probably occurs in Canada also. The rest of Mr. Walker's Tachydromias I can not decipher. They may belong to *Tachypeza* or to the present genus. Osten Sacken listed *vicarius* as a *Platypalpus*. The two-line description reads that the legs are slender which raises more doubt as to what the species really is.

Table of the North American Species of Tachydromia.

1. A white glistening pruinose spot between the front coxae and the humeri, rarely absent: wings with two dark bands: the distance between the two cross veins more than twice the length of the hind cross vein: arista terminal.....2.
   No glistening spot on the pleurae: wings with a single brownish subapical cloud or hyaline; cross veins separated scarcely more than the length of the hind cross vein: arista subterminal.....6.
2. Palpi and halteres black: marginal cell obliquely truncate **enecator** Melander.
   Palpi and halteres paler: marginal cell rounded at the end.....3.
3. Dark cross bands united along the costa.....**varipennis** Coquillett.
   Dark cross bands separated.....4.
4. Wings blunt, fringed with comparatively long hairs: propleurae not pruinose.....**ciliata** sp. nov.
   Wings slender, the marginal hairs short: propleurae pruinose.....5.
5. Legs nearly uniformly dusky.....**schwarzii** Coquillett.
   Base of legs pale yellow, outer portions in part black. **schwarzii** var. **diversipes**, var. nov.
6. Palpi black: wings with a broad subapical cloud. **maculipennis** Walker.
   Palpi yellowish: wings unclouded.....7.
7. Thorax shining, humeri prominent: palpi narrow.....8.
   Thorax and abdomen sub-glaucous, humeri smaller.....9.
8. Third and fourth veins divergent.....**simplicior** Wheeler & Melander.
   Third and fourth veins subparallel.....**calva** sp. nov.
9. Palpi long and narrow: scutellum with four bristles: antennae reddish **insularis** sp. nov.
   Palpi broader: scutellum with two bristles.....10.
10. Acrostichal and dorsocentral bristles present: legs slender piceous, antennae black.....**agens** sp. nov.
    Middle of dorsum without bristles: base of legs and of antennae yellow, last tarsal joint black.....**universalis** sp. nov.

Tachydromia enecator Melander.

Trans. Am. Ent. Soc., xxviii, 226, ♀ (1902).

Length 3¼ mm. Totally jet black, shining, except that the knees narrowly and the metatarsi are piceous, the palpi, antennae and halteres are dull black, and the hinder occiput, pectus, metanotum, a narrow vertical stripe on the metapleurae, front coxae, and underside of the front femora are provided with a light pruinose coating. Outer antennal joint elliptical, arista terminal. Humeral swellings of mesonotum large and well marked: no bristles on disc of mesonotum, scutellum with four minute bristles. The ♂ abdomen depressed, less shining apically, the hypopygium small, terminal, somewhat triangular in outline, it and the last ventral segment provided with short blackish hairs. Wings with two dark cross bands, the second vein appendiculate in the known specimens.

But five specimens are known of this species. The two cotypes, both females, are from Quebec and Wyoming. They are now located in the Wheeler collection at the American Museum of Natural History, New York City. I have a male and two females, collected by my former student, E. L. Jenne, at Douglas, Alaska, August 2, 1901. This is our largest species.

Tachydromia schwarzii Coquillett.

Coquillett, Proc. U. S. N. Mus. xviii. 440 (1895).
Melander, Trans. Am. Ent. Soc. xxviii. 225, fig. 52 (1902).

Length 2.5 mm. Shining black, the legs yellowish. Occiput and propleurae pruinose. Antennae fuscous to black, the outer joint rounded, the terminal arista about four times the length of the antenna. Facets of the eyes nearly uniform, front narrow. Palpi glistening white to dirty white, elongate and slender. Mesonotal disc shining, bristleless, scutellum with four short bristles. Hypopygium moderate, rounded, its curved slender appendages sometimes exserted. Legs including the coxae dusky yellow, the hind legs darkest, the tibiae and tarsi more or less infuscated. Halteres pale yellow. Wings slender, rather pointed, crossed by two broad brownish fasciae, leaving the base, middle and tip hyaline; the marginal cilia normally short.

This is a common insect in the West. During the entire summer it hurries about in quick little zig-zag runs in search of its small victims, curiously probing among grass, stones, sidewalks, houses, in fact it can be found almost everywhere in this region. I have seen hundreds of living specimens, and have examined nearly a hundred mounted individuals from Moscow, Idaho, and Pullman and Wenatchee, Washington. The types came from California and Utah. They are numbered 3246 and 3247 in the National Museum collection.

In structure, venation, and general appearance this species resembles *annulimana* Meigen, of the European fauna; which however has striped femora, incrassate front tibiae, an erect hypopygium, some dorsocentral bristles in front of the scutellum, and moreover lacks the white pruinose spots beneath the humeri.

Tachydromia schwarzii var. **diversipes** var. nov.

Melander, Trans. Am. Ent. Soc. xxviii. 225 (1902). *T. schwarzii*. var.

Male. Similar to *schwarzii* in all structural characters, but differing in coloration. The base of the legs is lighter, the outer portions blacker than in typical form, thus making a greater contrast in color. The coxae, trochanters, base of all the femora, the basal two-thirds of the front tibiae, and the tarsi except the tip almost white in color. The outer third of the front tibiae is abruptly black; the four posterior tibiae, except the knees, and the hind femora except the base, black. The palpi are blackish. The cross-bands of the wings are lead-gray, and are darker than is usually the case with *schwarzii*, where they generally have a brownish tinge.

Two males which I captured at Dry Creek, near Austin, Texas, April 20, 1901. The specimens were running over rather large stones in this moist ravine at the base of Mount Barker.

Tachydromia ciliata sp. nov.

Wheeler and Melander, Biologia Cent. Am, Dipt. Suppl. 375 (1901) *schwarzii*.

Female. Length about 2 mm. Quite similar to *schwarzii* in general appearance, but differing in the structure of the wings. Shining black, legs clear yellow except the infuscated outer two-thirds of the hind femora and tibiae. Antennae yellow; as they are defective nothing can be stated about the arista. Front narrow, facets of the eyes uniform. Palpi whitish. Occiput and thorax shining black, the propleurae not pruinose: humeri large and deeply constricted: the inner pair of scutellar bristles moderately long. First ventral segment white or whitish. Halteres yellow. Wings comparatively short and broad, blunt at the end, and margined with a conspicuous fringe of hairs which are prominent even on the costa; two brown cross-bands are present as in *schwarzii*, but because of the shortened wings the outer fascia appears less extensive; the third and fourth veins more distant from each other and continuing to the wing-tip without converging (in *schwarzii* they lie closer together and converge towards the tip).

I have two specimens before me from Guerrero, Mexico, one taken at Chilpancingo, at 4600 feet altitude, the other labeled Sierra de las Aguas Escondidas, 9500 feet. There are some minor differences between the two specimens. The former measures 1.75 mm. and has

the outer cross-band nearly as in typical *schwarzii*. The latter individual measures fully two mm. The base of its wings is less hyaline, but otherwise the wings are as described. The first ventral segment of the abdomen is only dusky, not white. The third specimen mentioned in the Biologia is in the Wheeler collection at the American Museum. This species corresponds to *excisa* Loew of the European fauna.

Tachydromia varipennis Coquillett.

Coquillett, Proc. Ent. Soc. Wash., v. 266 (1903).
Slosson, Ent. News, xiv. 266 (1903) habits.

Length 2 mm. Shining black, pro- and metapleurae pruinose, coxae, base of femora and proximal part of tarsi fuscous. Outer antennal joint short ovate, the terminal arista three times the length of the antenna. Palpi whitish. Humeri constricted from the central part of the thorax by an evident groove; no bristles on disc of notum, scutellar bristles minute. Hypopygium minute, terminal, without conspicuous hairs. Halteres white. Wings infumated, the base, tip and a transverse streak in the middle, but not including the marginal and submarginal cells hyaline.

I have four specimens from the type lot, received from Mrs. Annie Trumbull Slosson. They were taken in the White Mountains at Franconia, New Hampshire. The type is in the National Museum, number 6774. It is this species that is mentioned in Aldrich's Catalogue, page 314 under *schwarzii*, as occurring in New Hampshire.

In her article, Hunting Empids, in the October issue of the Entomological News for 1903, Mrs. Slosson gives the following notes on the habits of this fly. "About the first of July I always find here a pretty little creature running rapidly over wet stones at the margin of streams. It is a tiny fly with gray wings variegated with black, and its habits are odd and interesting. Though its wings are fully formed and quite capable of flight, it very rarely uses them. When pursued by the collector it runs swiftly like an ant on and around the stone, and will continue this elusive performance for many minutes, though by spreading its pretty wings it could at once escape capture. Only in desperate extremity, as a very last resort, will it sometimes take flight and rest upon another near-by stone. For a long time I found them very difficult to catch. But at last I discovered that by seizing the stone on which one was running and dropping it quickly into my net I had the little fellow safe and sound."

Tachydromia maculipennis Walker.

Walker, List Dipt. Ins. in Coll. Brit. Mus., iii. 507 (1849).
Loew, Cent. v., 74 (1863) *Tachypeza pusilla* ♀.
Melander, Trans. Am. Ent. Soc. xxviii. 228; and 229, f. 51 (*pusilla*); and 204, f. 1. (*Phoneutisca bimaculata*, Dakota specimens) (1902).
Coquillett, Proc. Ent. Soc. Wash. v. 266 (1903) *Phon. bimaculata*.
Aldrich, Catalog N. Am. Dipt., 310 (1905), *Phon. bimaculata*.

Length 2 mm. Shining black, antennae, palpi, proboscis and halteres also black, no pruinose spots on thorax. Outer joint of antennae short-conical, the arista two times the length of the antenna, almost terminal. Humeral swellings prominent, well constricted from the central portion of the thorax; no notal bristles; scutellum with four marginal bristles, the outer pair short. Hypopygium swollen, black hairy, the last ventral segment with a conspicuous fringe of black bristles. Legs largely blackish, the coxae, trochanters, and base of the femora paler; front tibiae and tarsi more or less yellowish; the last two tarsal joints black. Halteres whitish. Wings with a brownish cloud filling the submarginal and first posterior cells; the two cross veins approximate.

The type of this species, now in the Museum of Comparative Zoology, Cambridge, Massachusetts, was collected by LeBaron in Illinois. I have specimens before me from Chicago, Illinois, Milwaukee, Wisconsin, Atherton, Missouri (C. F. Adams) and Brookings, South Dakota (J. M. Aldrich). Dr. Hough has taken the species at New Bedford, Massachusetts. Mr. C. W. Johnson records *pusilla* from New Jersey in Smith's Catalog. The synonymy of this species is discussed in the introduction *antea*, page 52.

Tachydromia simplicior Wheeler and Melander.

Wh. and Mel., Biologia Cent. Am., Dipt. Suppl. 375 (1901) *Phoneutisca*.
Melander, Trans. Am. Ent. Soc. xxviii. 205, f. 6. (1902) *Phoneutisca*.

Length 1.5 mm. Body shining black, legs entirely yellow. Antennae short, the outer joint minute, smaller than the basal joint, the arista sub-dorsal. Palpi pure white, moderately broad. No bristles on mesonotal disc; scutellum with a pair of well separated marginal bristles; humeri well constricted and prominent; the sides of the thorax are very lightly pruinose, but there is no pruinose spot above the front coxae. Abdomen depressed, brownish hairy, the hypopygium small, terminal. Legs including the coxae yellow, the hind femora a little infuscated apically. Halteres yellow. Wings nearly hyaline, a very faint darker streak passes longitudinally through the middle of the wing; marginal cell short, submarginal cell full, third and fourth veins divergent.

A single male collected by Mr. H. H. Smith at Vera Cruz, January, 1888, from the Wheeler collection of the American Museum of Natural History. This specimen very likely belongs with the type female, which was collected in Chilpancingo in Guerrero. The two locations are on opposite sides of Mexico. The specimen is glued on a card and is not in the best of condition for description. The type has the third vein nearly straight. Here it is rounded in an even curve diverging from the fourth. This specimen has less of the purplish and bronze tinge to the body.

The definition characters of *Phoneutisca* led us to place this species in that genus. An examination of the true *Phoneutisca bimaculata* in the Museum of Comparative Zoology showed it to be quite a different insect than was supposed. The abruptness of the marginal cell in *Phoneutisca* is very striking.

Tachydromia calva sp. nov.

Shining black above, paler beneath, outer half of femora blackish. Antennae black, palpi slender, whitish, dorsum without evident bristles; wings lightly infumated, third and fourth veins sub-parallel.

Female. Front jet black, triangular; ocelli prominent, occiput with sparse short black hairs; eyes deeply and broadly emarginate at antennae, face obliterated by the contiguity of the eyes, facets nearly uniform. Antennae short black, last joint not as long as broad and smaller than basal joint, the arista subterminal, finely and closely pubescent, nearly five times the length of the antenna. Palpi narrowly elongate, whitish yellow: proboscis very small, black.

Thorax shining black, the humeri large, so that the thorax is nearly quadrate, a few microscopic dorsal bristles only, a single bristle in front of the wings scutellum with a pair of short bristles, the scutellum very lightly dusted. Abdomen pitchy black, sub-shining. Coxae, trochanters, basal half of femora and the tibiae yellow, outer half of femora blackened, tarsi a little dusky; front femora somewhat thickened. Halteres yellow. Wings narrow, nearly hyaline, lightly infumated especially noticeable at tip of first vein, marginal cell long, third and fourth veins parallel.

Described from a single female, presumably collected by Mr. G. R. Pilate as it bears the label, Tifton, Georgia, Sept. 25, 1896. The specimen was presented to me by Dr. G. deN. Hough. It measures one millimeter in length.

Tachydromia insularis sp. nov.

Male. Length 1.1 mm. Head and thorax pruinose; legs testaceous; wings clear hyaline; antennae reddish at base; palpi elongate, reddish;

scutellum with four black bristles; acrostichal and dorsocentral bristles microscopic; hypopygium large, flexed to the right.

Front narrowly V-shaped, cinereous; ocelli large, ocellar bristles present, black; first antennal joint testaceous, the outer joint fuscous, pubescent, arista subterminal, pubescent, four times the length of the antenna. Eyes completely contiguous on the face, facets uniform. Palpi twice as long as broad, sericeous, testaceous. Proboscis slender, vertical, piceous, one-half the height of the head. Occiput and entire thorax rather lightly covered with cinereous pollen; humeri comparatively small and not so deeply constricted as in the other species; the usual black bristles present along the sides of the notum; scutellum with two long decussating and two short bristles; acrostichal and dorsocentral rows of minute whitish bristles present, with about six bristles to each row, the last dorsocentral large; no pleural hairs. Abdomen brown-black, sub-shining, last segments black hairy; hypopygium large, globular, flexed to the right. Coxae shining yellowish, legs yellowish, femora dusky on the outer half, legs provided with short white bristly hairs, middle tibiae with series of minute black setulae beneath, front femora much thicker than the others. Halteres dusky. Wings clear hyaline, veins strong, hind margin ciliate; first posterior cell ending at wing tip, and there somewhat contracted, marginal cell a little longer than the submarginal along the costa.

Described from a single specimen labeled, Grenada, W. I., received from Prof. J. M. Aldrich.

Tachydromia agens sp. nov.

Male and female. Length 1.3 mm. Head and thorax pruinose, legs dark fuscous, wings clear hyaline; antennae blackish; palpi sub-quadrate, pale; acrostichal and dorsocentral bristles conspicuous, scutellum with four white bristles; hypopygium terminal.

Front broad above, narrow and sub-parallel below, cinereous; ocelli small, ocellar bristles small; occiput lightly pollinose, its cilia white and conspicuous; antennae small, black, the basal joint blackish, arista almost terminal, short, although four times the length of the antenna, microscopically pubescent. Eyes completely contiguous on the face, deeply but narrowly excised at the antennae, facets nearly uniform, those below larger. Palpi of male yellowish, one-half longer than broad, with three long terminal white hairs, in the female the palpi are dusky but with a white sheen. Proboscis black, no longer than the palpi, projecting somewhat forward.

Thorax cinereous pollinose, humeri round, not quite as broad as the interhumeral space, the furrow not deep except behind; all the thoracic bristles white, the acrostichal and dorsocentral rows well developed, the lateral bristles comparatively short, about a dozen in front of the wings: scutellum with two long and two short white bristles; no pleural bristles. Abdomen sub-shining olivaceous black, with sparse stubby whitish hairs, the lateral margins of the intermediate segments with the round black pits characteristic of *Coloboneura*, *Parathalassius*, etc. Hypopygium closed, terminal, elongate. Coxae shining,

posterior ones piceous, front coxae fuscous and with white hairs; legs dark fuscous, with whitish pubescence, middle tibiae setulose beneath, front femora somewhat the thickest, reddish beneath. Halteres yellowish; tegulae with a few white cilia. Wings clear hyaline, veins strong, hind margin short ciliate, marginal cell long, third and fourth veins parallel.

Type male collected on a windowpane July 3, 1906, in my house at Pullman, Washington. Type female taken in a wheat field nine miles west of Baird, Washington, June 23, 1908. This species was noticed actively running about the ground and stalks in wheat fields in several places in Central Washington. I have also five mounted paratypes which I collected at Lynden, Baird, and Pullman, all in Washington State.

Tachydromia universalis sp. nov.

Black, sparsely and lightly dusted; wings nearly uniformly hyaline; arista subterminal, the basal antennal joint red; palpi broad, white; legs reddish, variegated with brown; halteres yellow.

Male and female. Length 1.75 mm. Black, shining, lightly dusted with a gray pruinosity, which is more conspicuous on the pleurae, propleurae not glistening white. Antennae short, the two joints about equal in length, the basal joint red, the outer joint blackened, rounded oval, with a subterminal arista which is two and one-half times the length of the antenna. Front broad, its sides diverging above, the ocelli widely spaced. Upper facets minute, the lower ones larger. Palpi conspicuous, pendant, broad, white, with white hairs: proboscis black in the male, blackish in the females. Thorax comparatively broad, the humeri rather large but not long, the grooves rather distinct; acrostichals wanting, only a couple of weak dorsocentrals present near the scutellum; scutellum pruinose, and with two short bristles. Abdomen depressed, shining jet black, but overlaid with a light coating of gray dust: hypopygium large, shining, provided with a stout curved end-process which projects to the right; sides of the abdominal segments with minute muscle-attachment pits, as in *agens*. Legs reddish yellow, the upper side of the hind femora, the ends of the tibiae and the last tarsal joint darker; front femora thickened, hind femora scarcely reaching the last third of the abdomen. Halteres yellow. Wings rather broad, hyaline, but with a faint smokiness following the veins; veins strong, dark, but becoming yellowish at the base of the wing; marginal cilia minute; hind cross vein making an acute angle at the lower corner of the second basal cell.

Described from five specimens collected in the following widely separated localities: Chester County, Pennsylvania, June, 1902 (J. C. Bradley), Algonquin, Illinois, July 17, 1896 (Dr. Wm. Nason), and Austin, Texas.

This species is related to *agens* as is evident from the shortened broad thorax with the humeri less pronounced than in typical Tachydromias, the broad palpi, the widened front, subterminal arista, and pruinosity of the body. However it is readily distinguishable by the paler color of the legs, antennae, halteres and root of wing.

Catalogue of the Described Species of Tachydromia.[1]

1. *aemula* Loew, Zeitschr. Entom. Bresl. XVII. 22 (1863).... ...Eur. C.
*2. *agens* sp. nov..... .....Wash.
3. *aliterpicta* Becker, Act. Soc. Fenn. XXVI. 32 (1900).....Eur. S. C.
alteropicta Becker, Berl. Ent. Ztschr. XXXIII. 343. (1899).
*4. *annulimana* Meigen, Syst. Bes. III. 69 (1822).....Eur.
albitarsis Zetterstedt, Dipt. Sc. 1. 313 (1842).
arrogans Linnaeus. Zetterstedt, Ins. Lapp. 546. var. d. (1838).
cimicoides Fabricius, Walker, Ins. Brit. I. 140 (1851).
umbrarum Haliday, Ent. Mag. I. 161 (1833).
*5. *arrogans* Linnaeus, Fauna Suec. 1857 (1761)..... .....Eur.
bifasciata Rossi, Fauna Etr. Mant. II. 77 (1794).
cimicoides Fabricius, Spec. Ins. II. 447 (1781).
6. *brevipennis* v. Roser, Wuerttemb. Corresp. 1. 53 (1840).....Eur. C.
? *microptera* Loew, Ztschr. Ent. Bresl. XVII. 26 (1863).
*7. *calcanea* Meigen, Syst. Bes. VII. 95 (1838)..... .Eur. C.
longipennis Loew, Ztschr. Ent. Bresl. XVII. 29 (1863).
*8. *calva* sp. nov..... .....Georgia.
9. *catalonica* Strobl, Mem. R. Soc. Esp. III. 319 (1906).....Eur. S.
var. *striatipennis*, Strobl. l. c. 320.
*10. *ciliata* sp. nov.....Mex.
*11. *connexa* Meigen, Syst. Bes. III. 70 (1838).....Eur.
cimicoides Fabricius, Meigen, p. p. Klass. I. 239 (1804).
morio Zetterstedt, Ins. Lapp. 546 (1838).
12. *dichroa* Bezzi, Jenaische Denkschr. XIII. 183 (1908).....Afr. S.
*13. *enecator* Melander, Trans. Am. Ent. Soc. XXVIII. 226 (1902)
Alask., Wyom., Quebec.
14. *excisa* Loew, Zeitschr. Ent. Bresl. XVII. 27 (1863).....Eur. C.
15. *incompleta* Becker, Act. Soc. Fenn. XXVI. 33 (1901).....Siberia.
*16. *insularis* sp. nov.....Grenada.
*17. *interrupta* Loew, Zeits. Ent. Bresl. XVII. 19 (1863).....Eur. S.
*18. *maculipennis* Walker, List. Dipt. Ins. III. 507 (1849) N. Am.
pusilla Loew, Cent. V. 74 (1864).
bimaculata Loew, Melander, Trans. Am. Ent. Soc. XXVIII. 204.
19. *minima* Becker, Act. Soc. Fenn. XXVI. 32 (1901).....Siberia.
20. *monserratensis* Strobl, Mem. Soc. Esp. III. 318 (1906).....Eur. S.
21. ? *morio* (Zetterstedt) Walker, Ins. Brit. I. 141 (1851).....England.

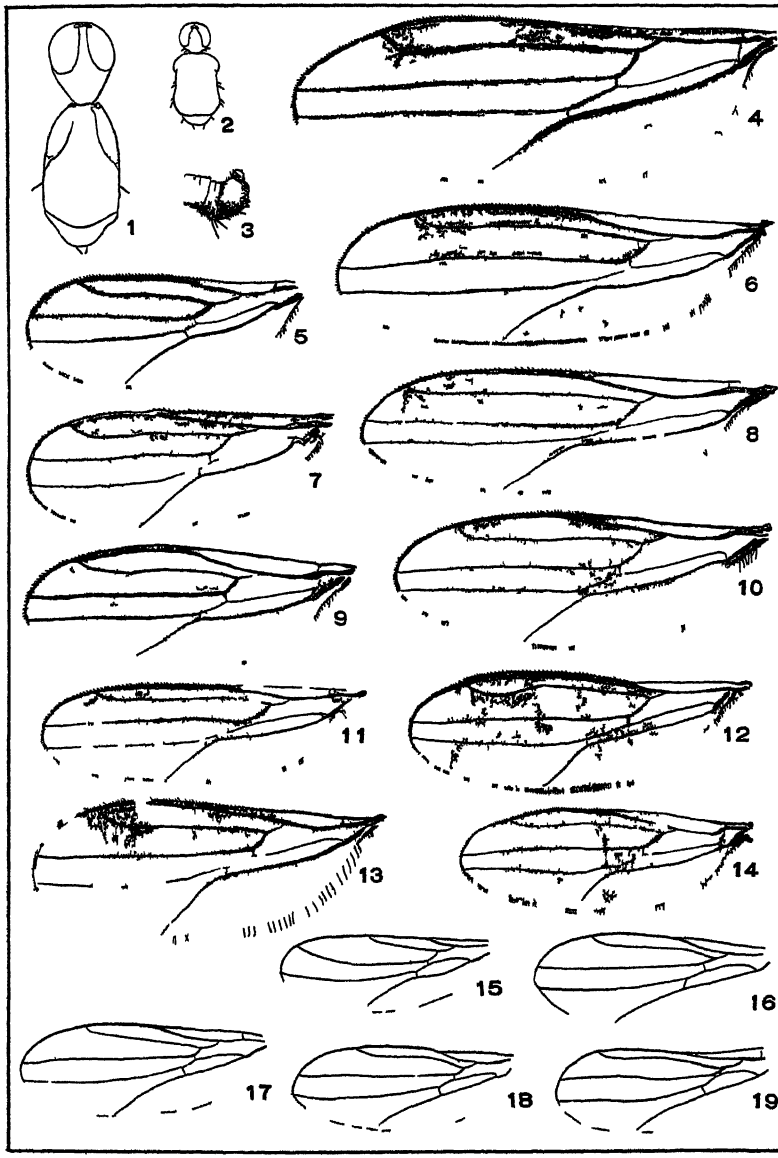
[1] Those species figured on the plate are marked with an asterisk.

22	*ornatipes* Becker Wien Ent Ztg IV 69 (1890)	Tyrol
23	*punctifera* Becker Act Soc Hemn XXVI 32 (1901)	Siberia
24	*subulosa* Meigen Syst Bes VI 312 (1830)	Eur N C
	fenestrata Zetterstedt Dipt Sc I 315 (1842)	
†25	*schwarzi* Coquillett Proc U S N M XVIII 140 (1895)	N Am W
	var *diversipes* var nov	Pen
†26	*simplicior* Wheeler and Melander Biologia C Am Dipt I 575 (1901)	Mexico
†27	*styriaca* Strobl Mitth Ver Steierm XXIX 124 (1893)	Alps
	var *semifasciata* Strobl l c 125	
28	*terricola* Zetterstedt Kon Vet Ak Handl 51 (1819)	Eur N C
29	*tuberculata* Loew Zeitschr Ent Bresl XVII 19 (1863)	Eur C
30	*undulata* Strobl Mem Soc Esp III 317 (1906)	Eur S E
†31	*universalis* sp nov	U S
†32	*variipennis* Coquillett Proc Ent Soc Wash V 266 (1903)	N H
33	*vittipennis* Bezzi Jenaische Denkschr XIII 182 (1905)	Afr S

Explanation of Plate 3

The figures are drawn to practically the same scale of magnification the camera lucida being used The enlargement is about twenty diameters As but four of the exotic species (*connexa* Meig , *incompleta* Beck *ornatipes* Beck , and *punctifera* Beck) have been figured, I have included drawings of the wings of those European species I possess

Fig	1	*Tachydromia enecator* Mel	Dorsal aspect of head and thorax
"	2	" *agens* n sp	" " " " " "
"	3	" *maculipennis* Walker	Lateral aspect of hypopygium
"	4	" *enecator* Mel	Wing
"	5	" *maculipennis* Walk	Wing
"	6	" *calcanea* Meig	Determination by Strobl Europe
"	7	" *connexa* Meig	Determination by Strobl Europe
"	8	" *styriaca* Strobl	Determination by Strobl Europe
"	9	" *interrupta* Loew	Determination by Strobl Europe
"	10	" *arrogans* Linn	Determination by Kertesz Europe
"	11	" *variipennis* Coq	
"	12	" *annulimana* Meig	Determination by Bezzi Europe
"	13	" *ciliata* n sp	
"	14	" *schwarzi* Coq	
"	15	" *simplicior* Wh and Mel	
"	16	" *universalis* n sp	
"	17	" *insularis* n sp	
"	18	" *calva* n sp	
"	19	" *agens* n sp.	



MELANDER TACHYDROMIA

THE INTRODUCTION OF A EUROPEAN SCOLYTID (THE SMALLER ELM BARK-BEETLE, SCOLYTUS MULTISTRIATUS MARSH) INTO MASSACHUSETTS.[1]

By J. W. Chapman.

The Scolytidae are most generally known as bark-borers and consequently many entomologists have given the name of bark-beetles to the entire group. They are a very important group of insects in as much as they are very nearly all tree-feeders. For convenience they might be put into two classes, those that attack our conifers and those that work almost exclusively on our deciduous trees of the forest and shade varieties.

We have found from experience in past years just how important economically are the beetles of the class that infest our conifers, since they have caused a loss of several millions of dollars yearly to different parts of our country.[2] It looks now, from the bark-borer which has recently attacked our elms, as though we were going to have an opportunity to learn of the second class of beetles in the same manner. Europeans have had this problem confronting them for years and it has proved to be one of the most serious with which they have had to deal, because many of these beetles have become such exclusive feeders that they will attack only one kind of tree.

In Germany the most destructive species to elms is the large Elm bark-borer, *Scolytus geoffroyi* Goetze or the "Grosser Ulmen-Splintkäfer" of which Eichhoff gives a good account.[3] He reports that closely associated with it and occurring on the same trees in a peculiarly neighborly or almost symbiotic fashion is the "Kleiner dichtgestreifter Ulmen-Splintkäfer" (*Scolytus multistriatus*). Just what this relationship signifies other than a social tendency of these insects one can hardly say. These two species confine their attacks chiefly to elm trees and considered together they are among the most dreaded pests in elm growing districts. In France the parks and boulevards of

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 18.

[2] Hopkins, A. D., Bark beetles of the Genus *Dendroctonus*, Bull. U. S. Bur. Entom., No. 83, pt. 1; The Genus *Dendroctonus*, Bull. U. S. Entom. Tech. Ser., No. 17, pt. 1, (1909).

[3] Die Europäische Borkenkäfer Julius Springer, Berlin, 1881.

Paris have been severely damaged and whole tracts of the elms have been killed.[1] In England the elms of London Park and southern England have been severely injured.[2] We see from this that *Scolytus multistriatus* is very widely distributed in Europe, since, as Eichhoff states, it covers the entire central portion of that continent.

This beetle was first found in the United States and recognized as *Scolytus multistriatus* Marsh in October, 1909, while extensive collections of Leopard Moth larvae were being made from limbs of elms and ash in the College yard, at Harvard. These limbs had to be barked and split for the purpose of securing the larvae of the Leopard Moth, and it was during this process that the *multistriatus* larvae were found. At that time the grubs were about full grown. No live adult beetles were found, but the mother of each brood was found dead in her chamber. A number of these females were extracted in a sufficiently perfect condition to make the identification of the species possible. This identification was kindly made for me by Dr. A. D. Hopkins of the Federal Bureau of Entomology.

After the species was identified I was desirous of knowing to what extent the trees in the surrounding country were infested, and to ascertain if possible about how long the beetles have been in this country. Under ordinary conditions this would have been a difficult matter. But the city of Cambridge was at that time removing from the streets in different parts of the city a hundred or more elm trees which were either dead or in a dying condition. These were all examined. The trunks and larger limbs of the majority of those that were taken out were yet alive. Different parts of the trees were carefully inspected in order to ascertain where the beetles first made their attack. Observations clearly showed that it was invariably above the middle upper part of the trunk, and usually on the larger limbs. The beetles are quite aggressive and as many as two hundred mother beetles were found in a space less than two feet square on a living trunk. Larvae were also taken from the smaller green limbs of standing trees. Without exception every felled tree examined showed hundreds of beetle markings and larvae. A representative number of those standing were carefully examined and nearly every one showed "shot-holes" of the beetles. It is difficult to ascertain the extent of the in-

[1] Barbey, A. Les Scolytides de l'Europe Centrale H. Kündig, Geneva, 1901.
[2] Gillanders, Forest Entomology, 1908.

festation of a standing tree until the bark is removed and this was not feasible. One could only make an estimate from the "shot-holes" that appeared on the external surface.

While making these observations a native American Scolytid, *Hylesinus opaculus* Leconte, which lives only in dead wood, was also found in abundance. Apparently this species has come to assume somewhat the same relation to *S. multistriatus* in this country as *S. multistriatus* does to *S. geoffroyi* in Europe, the only difference probably being that the American species hibernates in the adult beetle stage, while *S. multistriatus* hibernates in the larval stage.

About the middle of November a representative number of trees were examined in the College yard for bark-beetles. It was an exceedingly difficult task as the trees were large, and the "shot-holes" which the beetles make were difficult to locate. The trunks, large limbs and upper branches of each tree selected were carefully gone over. "Shot-holes" of the beetles were found on all of the trees and many of the adult beetles of our American species were busy, making temporary hibernating burrows. These could easily be located by the reddish boring dust which was freshly thrown out. Since these trees were selected in different parts of the yard with a view to making an estimate, I can say that it is quite likely that every tree in the yard harbors some beetles, but just how numerous they are cannot be stated.

I have not been able to follow the complete normal development of these beetles through and therefore do not know positively whether there is one or two broods annually. However, from the observations I have been able to make I feel quite secure in saying that there is only one brood. A number of small limbs which contained adult grubs were collected in October. These have been examined from time to time and up to date there has been no perceptible change in the larvae. The generations of these beetles vary considerably as is seen from the European reports. Eichhoff says that the same species may or may not have two broods annually, depending entirely on its geographical location. Gillanders reports that some of these bark-beetles have two broods in southern and one in northern England. Each of these writers mentions the fact that *S. multistriatus* may have two broods annually though this really seems to be an unsettled question.

Scolytus multistriatus confines itself almost entirely to elm trees, and to such a degree that it is known generally as the "smaller elm bark-beetle." Its habit of attacking injured or weakened trees gives

it practically an unlimited field in which to work as most of our park and shade trees are in a more or less unhealthy state, due to the lack of a proper amount of water and to crowding as well as to many other unfavorable conditions.

The first of December, 1909, some limbs which were about three inches in diameter and showed evidence of containing larvae, were sawed into short pieces and placed in the hot house in large glass jars. To get advantage of a high temperature the jars were placed directly over the steam pipes and kept well covered. Several times a week the pieces of limbs were submerged in water for an instant in order to keep them sufficiently moist so that development might continue. On January 13, 1910, the first adult beetles made their appearance. Some of the limbs were barked and pupae were found in various stages of development. The adult beetles were put into small dishes containing small pieces of fresh elm limbs. The females began almost immediately to make their burrows. When the galleries were about 10 mm. in length I noticed that the males were beginning to loiter about the mouths of the burrows, one male to each opening. Occasionally they would take a hand in removing the boring-dust from the entrance. Very often they would sally forth on a sort of exploration trip which would last only for a few minutes, then they would return to the same opening they had previously left. From two to five days after this relationship had begun copulation took place, and, as was supposed by Eichhoff and others, this occurred at the entrance to the burrow. The time required was from five to ten minutes in the cases observed. Activity was then resumed. The male seldom left the entrance afterwards but kept busying himself removing boring dust. The pairs that mated in this way were isolated with as little disturbance as possible and placed in other dishes in order that daily observations might be made on them. The females continued to excavate their chambers, which in this species are quite straight and always with the grain of the wood. Ten days after copulation I opened the chamber of one of the pairs that had been isolated. On each side of the mother gallery and connecting with it were miniature chambers. In each was a small, shining white egg, securely packed into its place by bits of boring dust. The two parent beetles were placed in another dish with some new elm. In a day or two both were found dead. I then opened the chamber of a second pair of beetles. This one contained eighteen eggs and it was somewhat longer than the first. I removed the parents

to another dish as had been done with the previous pairs. They immediately began work again as if they had never been disturbed.

The manner of excavating the egg galleries and the direction in which they are always made leave a characteristic marking by which the species can always be recognized. This peculiarity is more strikingly brought out when compared with the egg galleries of the other species (*Hylesinus opaculus*) Leconte shown on plate IV, figure 11. In this American species the mother gallery is two-armed and is always made across the grain of the wood. The adult *multistriatus* beetles are small, 2 to 3 mm. long. Thorax black, shining, somewhat longer than broad; elytra pitchy red; antennae and legs light-brown; elytra with close finely punctured striae; abdomen thickly covered with hairs, and viewed sidewise there is a strong horizontal projection on the second segment of the abdomen, which is peculiar to this species. (See plate IV, figs. 7 and 8.) The male is somewhat smaller than the female, with the front flat and thickly covered with hairs. The female has a convex front covered with few hairs, and on the third and fourth segments of the abdomen are prominent toothed projections. The larvae are scolytoid in character (see plate IV, fig. 6). As soon as they hatch the larvae eat their way into the surrounding wood at approximately right angles to the mother gallery (see plate V, fig. 10). When they become full-grown they pupate at the end of their burrow. This takes place according to the European accounts about the first week in May, or a little later. The adult beetles make their appearance in June and July. They come forth at this time in such numbers, says Eichhoff, that large, apparently healthy elms are attacked and completely destroyed in one season.

Since this species is so destructive and our experience with it is so limited, the following remarks, taken from European literature, ought to interest all those who desire to aid in the preservation of our shade elms.

In order to prevent an attack of the bark-beetle it is necessary to remove all centers of infestation from which they might spread to sound trees. Just how feasible this may prove to be depends, of course, on the local circumstances, but whatever care is exercised in other ways, it is very unlikely that much good will be done in lessening attack, so long as the inexcusable practice prevails of leaving trunks of infested elms standing, with the bark still on them, when this contains thousands of grubs which will shortly change to perfect beetles

ready to fly to the nearest growing elms. Scores of just such trunks as these may be seen on the streets and vacant lots of Cambridge and one can without difficulty strip off yards of the bark from them with the hands alone. If this bark is allowed to remain swarming with larvae it is an abiding and serious source of infestation and injury to growing trees. *If property owners would acquaint themselves with this fact, and of the mischief thus caused both to their own trees and to those of the neighborhood, they would undoubtedly take immediate steps to have the bark removed. All dead trees and old trunks with loose bark should have it removed and burned by the first of May, 1910, at the very latest. This will prevent thousands of these beetles from flying to other healthy trees, and thus be the means of protecting them from the attacks of the beetle.*

Observations are to be continued throughout the spring and summer, and a number of experiments will be conducted at the same time. These with further interesting data on the species will be reserved for a later paper.

I wish to express my gratitude to Dr. W. M. Wheeler for the many helpful suggestions which he has given, and to Mr. C. T. Brues for his kind assistance in preparing the plates.

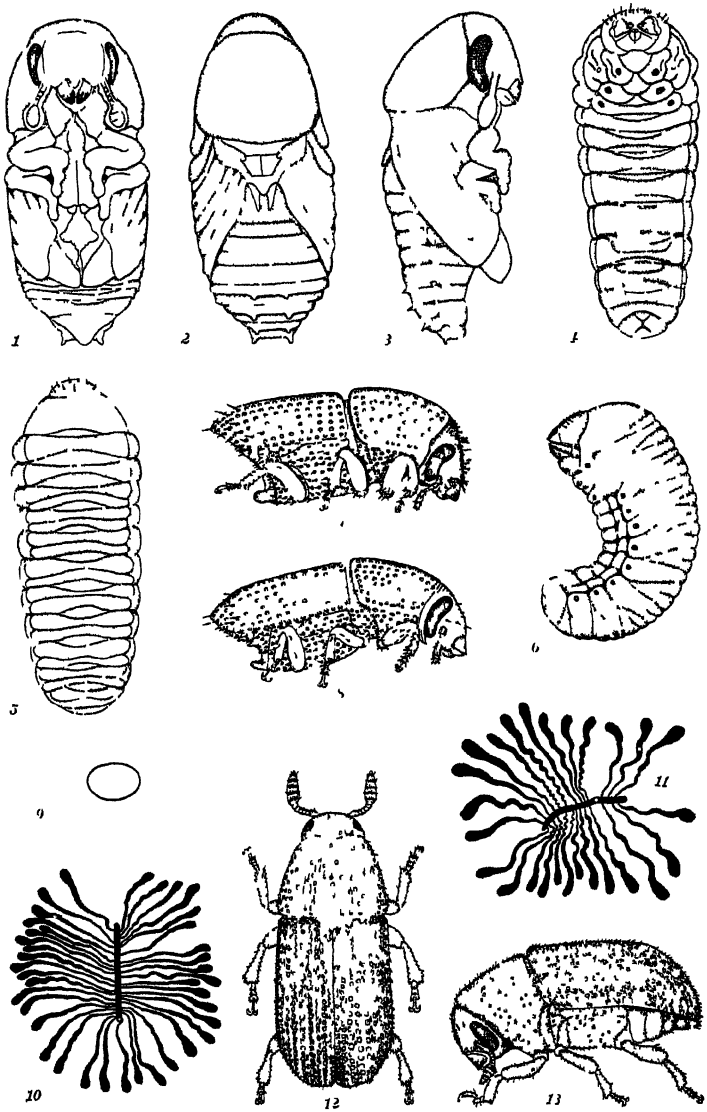
EXPLANATION OF PLATES.

Plate IV.

Fig. 1. Pupa — *S. multistriatus* Marsh.— Ventral view
Fig. 2. Same — Dorsal view.
Fig. 3. Same — Lateral view.
Fig. 4. Larva — *S. multistriatus*.— Ventral view.
Fig. 5. Same — Dorsal view.
Fig. 6. Same — Lateral view.
Fig. 7. *S. multistriatus* — Male
Fig. 8. *S. multistriatus* — Female.
Fig. 9. Egg outline, *S. multistriatus*.
Fig. 10. Mother and larval galleries of *S. multistriatus*.
Fig. 11. Mother and larval galleries of *Hylesinus opaculus* Lec
Fig 12. *Hylesinus opaculus* Lec. Dorsal view.
Fig. 13. Same — Lateral view.

Plate V.

Fig. 1. Markings of *S. multistriatus* in bark of elm.
Fig. 2. Showing "shot-holes" or exit holes of same.



CHAPMAN – SCOLYTIDAE

Fig. 1

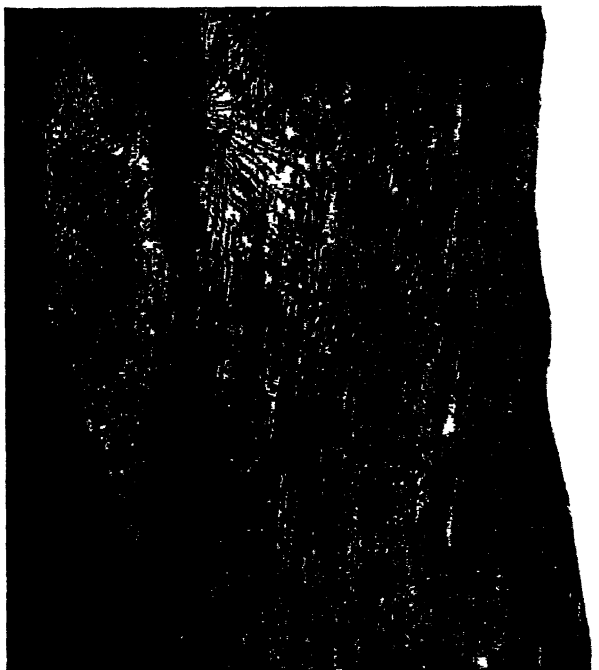


Fig. 9

CHAPMAN — SCOLYTUS MULTISTRIATUS MARSH

ON THE RESISTANCE OF GYPSY MOTH EGGS (*LIPARIS DISPAR* L.) TO COLD AND OTHER CONDITIONS.

By William Reiff, Harvard University.[1]

In the "Illustrierte Wochenschrift für Entomologie," Neudamm 1897, N. Kulagin has published a paper entitled "Zur Biologie von Ocneria dispar in Russland," in which the author says that a lowering of the temperature to –40° R. does not have any injurious effect on normally laid eggs of this moth. Eggs which are deprived of their protecting wool, however, will be killed by –15° R. (= –18¾ C.) Concerning the method of procedure in these experiments, Prof. P. Bachmetjew obtained more exact information from N. Kulagin by letters, which he includes in the first volume of his well-known "Experimentelle Entomologische Studien," Leipzig, 1901, p. 70. He says in this place that Kulagin depilated the eggs and left them for one month in a glass dish upon an open balcony. During this time the thermometer not infrequently reached –15° R. In the spring these eggs did not develop, although there were caterpillars hatching from other eggs kept upon the same balcony, but which were attached to a piece of wood with their hair. The question was left open as to the result of leaving eggs covered with hair during the winter in a dish of glass.

I was induced by these investigations to undertake in October, 1908, the following experiment: From dispar egg clusters obtained at Forest Hills, Mass., there were selected five clusters so divided that each egg cluster was separated into three nearly equal parts. One part of each five clusters was attached with good glue to a barky piece of wood and the second thirds of each were lightly pasted to the bottom of five open glass dishes, while the eggs of the last five thirds were entirely depilated and put into five other glass dishes. All three series remained constantly at the outside temperature, but protected from snow and direct contact with water. Two other egg clusters were divided in two nearly equal parts and one part of each cluster was put into a rather small wooden box, from which the cover had been removed. The eggs of the two remaining parts were depilated entirely and then placed separately in two other wooden boxes without covers.

[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 17.

All four boxes were sunk into the ground about three centimeters deep in an entirely open and unprotected place where they were allowed to remain. Snow and water were allowed free admittance to the eggs, but care was taken to allow the water to run off to a slight extent by means of a few very small holes which were cut in the bottom of the boxes.

A self-registering thermometer used recorded –21.5° C. as the lowest temperature of the winter 1908–09.

During the latter part of May, 1909, *the caterpillars from the eggs of all the series began to hatch simultaneously.* An examination made of all eggs which failed to hatch showed that *all* parts of the individual egg clusters presented about the same very small proportion of empty, dead or dried eggs, in each case a percentage of 5–8%.

The first result obtained which deserves notice, is the fact that the series of eggs which were deprived of their protecting hairs and passed the whole winter in glass dishes, withstood the cold just as successfully as those which had overwintered on a piece of wood covered with hairs in the normal way. If in Kulagin's experiment, the depilated eggs died which were exposed to the winter temperature for only one month in a glass dish probably the stated maximum temperature of –15° R. was more frequently reached, as Kulagin says himself, and perhaps also the temperature remained more constant. A continuous low temperature, however, did not occur in this locality during the winter of 1908–09, during which the temperature often fell very low but always rose again. It appears from this that the dispar eggs, from which the woolly covering has been removed, can withstand quite severe cold without injury, provided that this temperature does not endure too long. Or perhaps may it be that the woolly covering of the eggs laid by the female dispar, which withstand the very cold winter of Russia is stronger and thicker than we find here? If this be the case, the depilated eggs of Russian masses should exhibit a slighter resistance, for the eggs on account of the thick covering should be less accustomed to cold.

How very resistant the dispar eggs may be to the various influencing factors of the winter, is shown by the last two series of experiments, in which even depilated eggs withstood snow and water as well as low temperature without damage. To consider the practical application of these experiments, it appears that dispar eggs which have been removed from their normal location through some accident and have

fallen singly to the ground, can easily withstand the winter even without their protective covering. Simply tearing off the eggs from their attachment, which is occasionally done in private yards and similar places, has absolutely no effect in killing the eggs.

In connection with these experiments something may be said concerning the sporadic diffusion of the Gypsy moth in the New England States. As is well known, *Liparis dispar* frequently makes its appearance in places far removed from any sort of traffic, for example in the middle of a wooded area, in which any introduction by railroads, vehicles or other means of transportation is entirely excluded. There has hitherto been no explanation of the way in which the gypsy moth reached these isolated places. I will pass over the supposition, which one hears here and there, but which cannot be taken seriously, that birds drop caterpillars, which they have previously picked up, and thus aid in the spread and dissemination of the gypsy moth. In the first place, a caterpillar which had been dropped from the bill of a bird, would be in so very few cases so slightly injured that it could develop into a moth, and in the second place, at least one male and one female caterpillar would have to be dropped in precisely the same place to provide for the possible establishment of a dispar colony. Also the explanation of dissemination by the dropping of a fertilized gravid dispar female in the same manner is not at all plausible. The dispar females almost always deposit their eggs immediately after fertilization has taken place, so that the chance of birds capturing a fertilized female with eggs is very improbable. Furthermore a dropped dispar female, injured by a bird's bill would hardly be able still to lay its eggs.

Lately there has appeared in the fifth edition of the "Naturgeschichte der deutschen Vögel" by C. G. Friderich, Stuttgart, Verlag für Naturkunde Sproesser & Nägele, 1905, a highly interesting paper by Alexander Bau "Ueber Nutzen und Schaden der Vögel und über Vogelschutz." A short report of this article is given in No. 35, Vol. XVIII of the "Entomologische Zeitschrift," Guben (Germany) 1905. As a result of very exact investigations, which the author undertook and for which he was particularly well fitted through his extensive experience as entomologist as well as ornithologist and forester, Alexander Bau reached the conclusion that the assumed economic benefit of insectivorous birds should be constantly questioned. The part of his paper of perhaps the greatest interest deals with examinations of the

stomachs of the birds and experiments made as a direct result of these. Thus Bau has found in the stomachs of jays (Eichelhaher) egg-masses of *Malacosoma neustria* (German Tent caterpillar), eggs of Orgyia antiqua (German Tussock moth), eggs of *Psilura monacha* (the "Nun" of the Germans), together with eggs of other Bombycid moths. He has proved by various experiments that all these eggs pass out *undigested*, protected by means of their extremely hard chitinous shells and remain *in a living state*. Therefore the author naturally concludes that birds even help to propagate injurious insects. In this way Bau's experiments furnish an explanation for the sporadic distribution of the gypsy moth, which is, as is known, a close relative of the European *Psilura monacha*. Dispar eggs have exceedingly strong chitinous shells also, which are undoubtedly resistant in the same manner against the decomposing action of the digestive juices of the birds' stomachs.

THE GREEN BUG AND ITS NATURAL ENEMIES, A STUDY IN INSECT PARASITISM. By S. J. Hunter. Bull. Univ. Kansas, Vol. 9, No. 2, pp. 163, figs. 48, Pls. 9, October, 1909.

This extensive paper deals with the relations existing between *Toxoptera graminum*, the Green Bug and its parasite, *Lysiphlebus tritici*, and deals in great part with the successful artificial dissemination of the parasite in Kansas. It contains however, much good biological matter concerning both species, particularly the parasite which was extensively studied experimentally with regard to its variation, reproduction, habits at different temperatures, etc. Much is added to our knowledge of the bionomics of *Lysiphlebus*, and one remarkable conclusion reached is worthy of special mention. It was found that parthenogenetic *Lysiphlebus* produce almost entirely males, but that a very small proportion of females regularly appear among such offspring. Unfortunately the report contains a considerable amount of controversial matter and numbers of detailed tables are printed at great length where it would seem that short summaries might have served the purpose much better.

C. T. B.

SMALL ARTIFICIAL ANT-NESTS OF NOVEL PATTERNS.

By William Morton Wheeler,
Harvard University.

The study of the behavior of ants, which is attracting an ever increasing number of investigators, has led to the invention of several different patterns of artificial nests. Those used by the older writers, such as Swammerdam [1], Pierre Huber [2] and Lubbock [3] contained earth, and some of the more modern nests recommended by Wasmann [4] and others also contain this substance. A new departure was initiated by Janet [5] in his plaster of Paris nests and by Miss Adele M. Fielde in the glass nests which she has devised [6], since both of these investigators dispense with earth as an untidy, and superfluous accessory. Veihmeyer [7] has suggested some improvements in the construction of the Janet nest, and Miss Buckingham [8] and I [9] have endeavored to introduce certain modifications in the structure of the Fielde nest; Miss Buckingham substituting aluminum for the glass base, thus greatly diminishing its weight, while I have substituted plaster of Paris, thus combining the principles of the Janet and Fielde nests and facilitating construction. Emery [10] has very recently published an account of a modification of the Janet nest, which, owing to its cheapness and durability, and the ease of its construction, merits the attention of all those who are studying living ants in the laboratory. I subjoin a translation of his directions for making this piece of apparatus.

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[1] Biblia Naturæ, Leyden 1737.

[2] Recherches sur les mœurs des Fourmis indigènes. Paris et Genève, 1810.

[3] Ants, Bees and Wasps. Rev. Ed. Internat. Sci. Ser. N. Y. Appleton & Co., 1894.

[4] Die psychischen Fahigkeiten der Ameisen. Zoologica XI, 26, 1899, 132 pp. 3 pls. Rev. Ed. 1909, 188 pp. 5 pls.

[5] Appareil pour l'Élevage et l'Observation des Fourmis. Bull. Soc. Zool. France, XVIII, 1893, pp. 168–171; Appareils pour l'Observation des Fourmis et des Animaux myrmécophiles. Mém. Soc. Zool. France X, 1897, 22 pp., 3 figs., 1 pl.

[6] Portable Ant-Nests. Biol. Bull. II, 1894, pp. 81–85, 3 figs; Portable Ant Nests, ibid., VII, 1904, pp. 215–220, 1 pl. 2 figs.

[7] Beobachtungsnester für Ameisen, "Aus der Heimat," 1905, Heft 1, 11 pp., 6 figs.

[8] A Light-weight, Portable Outfit for the Study and Transportation of Ants. Amer. Natur., Oct. 1909, pp. 611–614.

[9] On the Founding of Colonies by Queen Ants, with Special Reference to the Parasitic and Slave-making Species. Bull. Amer. Mus. Nat. Hist., XXII, 1906, pp. 33–105, 7 pls., 1 fig.

[10] Kleine Künstliche Ameisennester, Zeitschr. f. wiss. Insektenbiol. V, 1909, p. 403.

"This summer I have used a style of artificial nest which is excellently adapted for experiments on a small or very small scale, e. g. for making observations on single fertilized queens while they are founding their colonies. These nests have, moreover, the advantage of being extremely cheap and easy of construction.

"I make these nests from hollow tiles, such as are used in building light walls. These tiles, which are perforated with holes, are sawed, at right angles to the holes, into plates of the required thickness. Since the saw is soon blunted by this operation, I use an old one that is more or less worn.

"Then I have each plate ground down till it is smooth on both sides. On one of these sides, which is to become the floor of the nest, I fill in the openings with plaster of Paris, and the other side is covered with a glass plate of suitable dimensions. The cavities can then either be left as so many separate chambers or connected with one another by means of grooves, or even have one of their walls perforated with a glass tube to serve as a communication with some other piece of apparatus. One of the chambers can be used as a water reservoir (as in the Janet nests) and remain isolated while the others are made to communicate with one another by means of grooves.

"A convenient method of supplying these nests with the requisite amount of moisture is to place them on a layer of damp moss.

"Plates of hollow tiling may also be conveniently employed as porous and quickly drying bases for ordinary Janet nests, as their lower surfaces are thereby prevented from becoming mouldy."

A small artificial nest of still a different pattern is employed by Dr. F. Santschi of Kairouan, Tunis, in his studies on colonies of diminutive ants which have to be kept in very tight receptacles. He described its construction to me in the course of a conversation, which I had with him in Lausanne during the past summer, as follows:

The base of the nest consists of a rectangular glass plate, such as is most conveniently obtained by cleaning an unsuccessfully exposed photographic plate of ordinary dimensions, say 3×4 or 4×5 inches. Wet plaster of Paris is poured onto this plate in the form of the heavy lines in the accompanying diagrams, which represent nests with two and three chambers respectively, connected by galleries. Of course, any other design which suggests itself as suitable, may be used instead, if desired. Before the plaster has set, a second glass plate of the same size and shape as the base and previously covered with a film

of sweet oil is pressed down onto the plaster till it forms walls only a few millimeters in height. After the plaster has set, the roof-pane is removed, cleaned and cut into two or more pieces with a diamond along lines (dotted in the figures) which bisect the short galleries, and then replaced as covers of the chambers. The ants can be introduced into the nest by sliding the covers apart a short distance over one of the galleries. The plaster is sufficiently porous to provide for ventilation and a thin slice of wet sponge or a tuft of wet moss or cotton, placed in one of the chambers, will furnish the requisite amount of moisture. Nests of this description are very useful as they can be placed on the

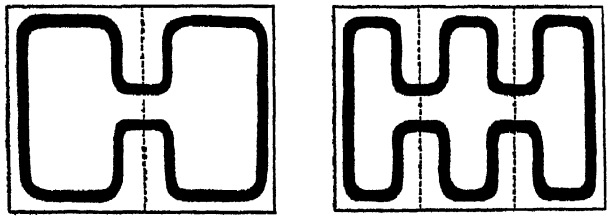

Fig. 1. Diagrams of nests devised by Santschi

stage of the compound microscope, or preferably of the Zeiss binocular and their inhabitants studied under a low objective. Santschi recommends his nests for the study of such small ants as the various species of *Leptothorax*, *Myrmica*, *Tapinoma*, *Bothriomyrmex*, *Myrmecina*, *Stenamma*, *Goniomma*, *Oxyopomyrmex*, etc., and their parasites and myrmecophiles, but they would be equally useful for very small colonies of larger ants and for studies on the foundation of colonies by single queens, not to mention all observations in which a few workers are to be kept in isolation for some purpose. These nests can be so easily and rapidly made that they will prove to be very useful for travelers.

A NOTE ON THE SPECIES OF FUCELLIA OF EASTERN NORTH AMERICA.

By Charles W. Johnson.

I have been greatly interested in the paper by Prof. P. Stein, "Zur Kenntnis der Gattung Fucellia Rob. Desv.," (Wiener Entom. Zeit., XXIX, p. 11, 1910). A study of all the material at hand (over 60 specimens), shows that all are referable to *Fucellia marina* Macq. and not to *F. fucorum* Fall. In referring to the distribution of the latter in Europe, Prof. Stein says: - "The true *F. fucorum*, as Lundbeck comprehends in his "Diptera groenlandica," is found very rarely on our German coasts and belongs more to the far North. I did not find it in any collection of my dipterological friends, for all that were sent to me under the name fucorum belonged to *maritima* Hal. I myself caught only a single male in Thiessow on the Island of Ruegen, together with *maritima* Hal. But as I took with it comparatively few specimens, that I at that time held for the same species, it is possible that after all *fucorum* is also more abundant on Ruegen. On our Baltic coasts I have never yet observed it. When Lundbeck declares that the species is spread over the greater part of Europe as far as Trieste, this rests on the assumption that the *fucorum* quoted by the author is Fallen's species, which is, in fact, not the case. Aside from a type of Lundbeck's, specimens are before me that were caught in Alaska (St. Paul Isl.), Friday Harbor (Washington, U. S.), and in Behring Str. (Miednaja)."

Among some diptera obtained by several collectors in Labrador and Newfoundland I find only *F. marina*. Still there is little doubt but that *F. fucorum* is to be found on those shores, but very doubtful if it will be found as far South as New England. The following table comprises the four species from Eastern North America:--

MALES.

1. Posterior femora on the underside at the base with a thick tuft of short bristles, apex of the wing not clouded.....2
   Posterior femora without the thickened tuft of bristles at the base, but on the underside along the whole length with rather strong bristles of nearly equal length, apex of the wing clouded.....**pictipennis** Beck.

2. Middle tibiae without bristles on the inside, tibiae and palpi for the greater part reddish yellow, rarely darkened . . . . **marina** Macq.
   Middle tibiae on the inside with one or two distinct bristles, palpi and legs entirely black 3
3. Posterior femora only on the underside with a rather small bristle tuft, halteres blood red . . . . . **ariciiformis** Holmgr.
   Posterior femora in addition to the bristle tuft, on the underside with a knob-like swelling turned toward the body and set with short bristles, halteres yellow . . . . . **fucorum** Fall.

FEMALES.

1. Tibia for the most part yellow, tarsi and femora for the most part black, middle femora on the underside only with very fine, short hairs. **marina** Macq.
   Tibiae for the most part black 2
2. Posterior lower sternopleural bristles wholly wanting or only indicated by a quite fine short hair, apex of the wing distinctly clouded. **pictipennis** Beck.
   Posterior lower sternopleural bristles distinct even if short, apex of wing not clouded 3
3. Middle femora only on the underside behind with a few longer bristle-like hairs, halteres yellow . . . . . **fucorum** Fall.
   Middle femora not merely on the underside behind, but also on the underside in front with several comparatively strong bristle-like hairs, halteres blood red . . . . . **ariciiformis** Holmgr.

A study of all the original descriptions of the species suggested as synonyms by Prof. Stein, seems to point conclusively to the fact that the synonymy will have to stand as follows:—

Fucellia marina Macquart.

Scatophaga marina Macq., Ann. Soc. Ent., France, VIII, 242, pl. 11, fig. 3. Oct., 1838.

Scatophaga (*Halithea*) *maritima* Haliday, Ann. Nat. Hist., II, 186, Nov., 1838.

Fucellia arenaria Desv., Ann. Soc. Ent., France, X, 272, 1841.

Fucellia intermedia Lundbeck, Dipt. Groenl.,— Videns. Meddel. Nat. Foren., Kjoebenhaven, 1901, p. 291, fig. 1 b.

Fucellia maritima Stein, Wiener Ent. Zeit., XXIX, 18, 1910.

In referring to the synonymy in his introduction, Stein shows that the type of Fucellia is *F. arenaria*, the only species mentioned by Desvoidy under his generic diagnosis, and suggests that Desvoidy's statement that the female has the tuft of bristles on the posterior femora was undoubtedly a slip of the pen. Prof. Stein further states

(as Mik has also done), that there are a number of species of *Fucellia* in which the posterior femora are simple in both sexes, and which yet belong to *Fucellia* beyond a doubt.

The specimens before me show the following distribution: Great Caribou Isl., Labrador, July 11th (G. M. Allen); Caribou Isl., Lab., (Packard); Funk Isl., Newfoundland, July (Owen Bryant); Eastport, Me., July 15 (Johnson); Dover, N. H., April 11 (Bridwell); Hampton, H. N. (Shaw); Beverly, Mass., April 21 (A. P. Morse); Framingham, Mass., June 6 (Frost); Cohasset, Sept. 8 (Bryant); Fall River, Mass., April 20 (N. S. Easton); Kingston, R. I., March 27 (Barlow); New Haven, Conn., Nov. 9 (Viereck); Clemonton, N. J., April 15, and Philadelphia, Pa., March 12 (Johnson); Bermuda, March 6 (F. M. Jones); St. Augustine and De Funiak Springs, Fla., March 1st (Johnson); Charlotte Harbor, Fla. (Mrs. Slosson).

From the Pacific Coast Prof. Stein has described five new species: *Fucellia hiercuciata*, Behring Strait; *F. costalis*, Monterey, Cal.; *F. antennata*, Alaska; *F. separata*, Monterey, Cal. and Seattle, Wash., and *F. rufitibia*, Pacific Grove, Cal.

The Mating Habits of Empididae. Hamm, A. H. Observations on *Empis livida* L. Ent. Month. Mag. XIX, pp. 181–184; Observations on *Empis opaca* F., Ibid., XX, pp. 132–134; Further Observations on the Empinae, Ibid., XX, pp. 157–162.

It appears to be the regular occurrence among many species of *Empis*, and also in at least some species belonging to *Pachymeria* and *Rhamphomyia*, for the males to capture small Diptera and other insects which they paralyze with their beaks, and then offer to the females to feed upon during copulation. The male does not appear to partake of this food itself and simply offers it to the female which devours it while pairing. Several other species of *Empis* were found to copulate without prey, and females of these were found feeding at other times, although those which copulate with prey were not found to feed at other times.

C. T. B.

A HOPPERDOZER FOR ROUGH GROUND.

By Albert P. Morse, Wellesley, Mass.

During the last few years a large part of New England has been subjected to a series of extremely dry summer seasons. This climatic condition is favorable to the development of locusts or "grasshoppers" in itself, and at the same time diminishes the ravages of fungous diseases which tend to hold them in check, and stunts the vegetation on which they feed. As a natural consequence several species have multiplied to such an injurious extent, at least locally in parts of Vermont, New Hampshire, and Maine, that it is wise to consider means of artificial control.

Of the various methods of fighting grasshoppers which become locally injurious, two are of especial importance: — viz., 1st, plowing of the breeding-grounds before they hatch (or immediately thereafter), thereby burying and destroying them; and 2nd, destruction of the young before they have done much injury or are able to travel far.

Where the breeding-grounds are not now known, or an extended watch cannot be kept at hatching-time and immediate action taken, the first method cannot be considered available for the coming season. Or again, the breeding-grounds may be of such a character that plowing of them is impracticable, either by reason of their stoniness, steepness, location, or the injury which would result from washing by rains.

The second method of control — destruction of the young — may be effected under some circumstances by poisoning the vegetation in and near the hatching grounds, with arsenicals, or by the use of poisoned baits such as bran-mash or dried horse-droppings, both of which are attractive to the young 'hoppers. The use of arsenicals in pastures, however, is impracticable, and it is probable that by far the larger part of the New England breeding-grounds are used for that purpose. Another very effective method of destroying the young is by the use of "hopperdozers," long, flat, shallow pans containing kerosene or kerosene and water, which are drawn by horses over the infested fields and into which the young locusts leap and are destroyed. These, however, can be used effectively only on relatively level ground and have the disadvantage of imparting to the forage a flavor decidedly repugnant to stock. A hopperdozer to be of use in New England

should be free from this defect and should be of such construction as to allow it to be used on very uneven ground.

Freedom from repugnant odor can be secured by substituting for the coal-oil pan a piece of sheet-iron or other flat surface smeared with a suitable adhesive substance of which we have at hand an excellent one in what is known as "Tree Tanglefoot," largely used to prevent caterpillars of the gypsy-moth and canker-worms from ascending trees. A young grasshopper falling upon a surface coated with this preparation is there to stay.

The second need - - adaptability to an uneven surface — may be secured by constructing the machine in sections, say two-and-a-half

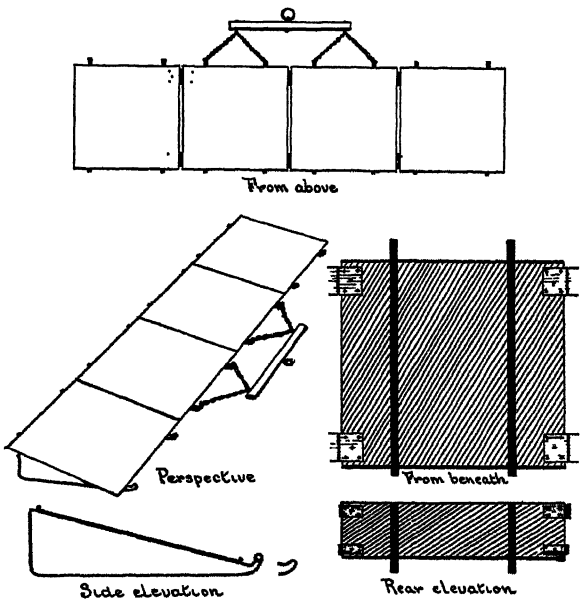

Fig. 1. For destroying grass-insects on rough ground where the use of kerosene is objectionable and the ordinary form of machine cannot be used. Designed by A. P. Morse

or three feet long, hinged so as to be freely movable on each other, thus allowing a much closer approximation to the surface of uneven ground than is possible with a rigid pan or plate ten or twelve feet in length. The following sketches illustrate such a device, made of No. 24 galvanized sheet iron in four sections, with iron or steel runners,

so constructed as to allow considerable movement in a vertical plane, and even a folding-over of the end-sections on the middle ones for convenience in transportation. Such a machine can be readily made by a handy blacksmith, or a substitute therefor may be built of boards by any farmer, the principle remaining the same. The front and rear edges of the iron plates should be stiffened with iron rods, and the front edge should be about two inches from the ground. The runners should be of such form as to pass over minor obstructions on the ground and to permit movement backwards, for convenience.

Such a machine, properly coated with "Tree Tanglefoot" and drawn by a horse over pasture and mowing-lands during the early stages of development of the 'hoppers would capture them in large quantities, and in addition destroy myriads of leaf-hoppers (Jassidae), spittle-insects (Cercopidae), plant-bugs (Capsidae), and other grass- and grain-inhabiting insects.

A Monographic Revision of the Twisted Winged Insects Comprising the Order Strepsiptera Kirby. By W. Dwight Pierce, Bull. U. S. Nat. Mus., No. 66, pp. 232, pls. 15; figs. 4. (Dec. 1909.)

This extensive contribution represents the first attempt made to gather together and correlate the considerable amount of scattered information at present available concerning this most aberrant and interesting group of insects, and in addition it contains a large amount of new matter, relating principally to the North American members of the order.

The Strepsiptera are regarded as an order, a view which will probably receive the endorsement of other workers, although there are some such striking similarities between them and Rhipiphorid Coleoptera that it is difficult to regard them with Pierce as more closely related to the Hymenoptera and Diptera. One point upon which much stress is laid, the presence of the group in Baltic amber of Tertiary age, cannot carry conviction, for we know that in other specialized orders many amber species are almost indistinguishable from living ones.

Following his preliminary classification of the Strepsiptera published in 1908[1] the author divides the order into four superfamilies

[1] A Preliminary Review of the Classification of the Order Strepsiptera, Proc. Ent. Soc. Washington, Vol. IX, pp. 75–85.

to make its classification accord with that which has been proposed for some of the other orders of insects, but owing to the compact nature of the group he has been compelled to select slight, single characters, and each superfamily differs from the one preceding it by the loss of one tarsal joint in the male. Similarly the eight families are segregated by the number of joints and form of the flabella of the antennae. Due to the extremely degenerate form of the females, still less evident characters are available for their classification. It seems unfortunate that such a very ambitious and cumbrous grouping should have been adopted for it can hardly fail to confuse the student who is not a specialist in the order, and to make it appear out of its proper proportion in the taxonomy of insects in general.

103 species are listed and described, belonging to 37 genera, 24 of which are monotypical, while 15 or nearly half the species belong to two genera. 69 of the species, all but 7 of which are from North America, are described as new. Many of the species known from only females or single specimens appear to be very closely related, and Pierce assumes that each parasite species can be defined by its host species. Time only can tell whether such a supposition is correct, but the more definite knowledge which we have concerning other parasitic insects shows that such generalizations should not be made too hastily, especially when they relate to the genera of hosts and parasites. A case of such association is the genus *Homilops* where species known only by females are segregated with one known only by the male on account of their hosts being congeneric.

In addition to many figures, there are full descriptions of all new species, and collected literature relating to all exotic ones, as well as a very complete compendium of the known facts regarding the development, anatomy, and ethology of the group. This will form a splendid basis for future work, which it is to be hoped will be undertaken by many entomologists.

A very extensive bibliography of fifteen pages completes the paper. Some of the references will appear superfluous to working naturalists, however, such as yearly citations of the Zoological Record, and the Zoologischer Anzeiger, and the inclusion of the Century Dictionary.

C. T. Brues.

PSYCHE

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COLONIES OF ANTS (*LASIUS NEONIGER* EMERY) INFESTED WITH *LABOULBENIA FORMICARUM* THAXTER.

By William Morton Wheeler.

Harvard University.

It appears, from the exhaustive researches of Prof. Roland Thaxter, the leading authority on the Laboulbeniaceæ, that only two species of these extraordinary ectoparasitic fungi are known to occur on ants. One of these species is *Rickia wasmanni* Cavara, found by Wasmann on *Myrmica levinodis* Nyl. at Linz on the Rhine; the other is *Laboulbenia formicarum* which Thaxter has taken at Cambridge, Mass. on *Lasius niger* L. var. *americanus* Emery and *Formica subpolita* Mayr var. *neogagates* Emery. Both species are described and beautifully figured in the second part of Thaxter's "Contribution toward a Monograph of the Laboulbeniaceæ," Mem. Amer. Acad. Arts and Sci., Vol. XIII, No. VI, 1908, pp. 218 and 359, Pl. XXXIV., Figs. 1-13 and Pl. LVIII, Figs. 14, 15.

For some time I have been looking for Laboulbeniaceæ on the ants which I have collected myself or received from correspondents, but it was not till very recently that I happened on any specimens of these fungi. April 20–24, while collecting insects on the seashore at Ellisville, Mass., a small settlement about twelve miles south of Plymouth and six miles north of Bournedale, I came upon two localities about a mile apart, in which nearly all the colonies of *Lasius niger*, var. *neoniger* were infested with what Professor Thaxter has kindly identified for me as the second of the two species of Laboulbeniaceæ mentioned above, namely *Laboulbenia formicarum*. I first found a number of infested *neoniger* colonies a mile south of Ellisville in a small triangular area about a dozen yards in diameter and adjoining the beach. The soil of this area consists of a mixture of sand and humus and must be well within the reach of

the salt spray during stormy weather. A few days later I discovered a much larger area, comprising a narrow strip about a quarter of a mile in length and forming the border of a salt meadow between Salt Pond and the beach at Ellisville. Here there are dozens of infested colonies which have a very definite and interesting distribution. On the beach itself, which consists of a deep layer of pure sand, there are colonies of *Formica fusca* var. *argentata* Wheeler, *Myrmica scabrinodis* Nyl. var. *sabuleti* Meinert, *Tapinoma sessile* Say and *Lasius neoniger*. The last is far and away the most abundant and its workers are of large size. None of the ants in this locality, including the *neoniger*, was found to be infested with Laboulbeniaceæ. On the border of the salt meadow, however, immediately adjoining the beach, where the soil is moist, consisting of a mixture of rather sour, decomposing humus mixed with sand, and probably not infrequently wetted by the spray and occasionally even submerged at very high water, the only ant is *L. neoniger*, but its colonies are less populous than those on the beach, the workers are distinctly smaller and are practically all infested with the *Laboulbenia*. Passing over from this zone of infestation to the pasture land adjoining the salt meadow, the variety *neoniger* is replaced by *L. niger* L. var *americanus* Emery which is the form of the species commonly occurring in higher and dryer pastures and fields. None of the workers of this form, which lacks on the scapes and legs the erect hairs so conspicuous in the var. *neoniger*, was found to be infested with the fungus. It would seem, therefore, that while *neoniger*, unlike any of the other ants, is able to exist in a depauperate condition in the damp, sour soil at the edges of salt meadows, it does so only at the risk of becoming infested with *Laboulbenia formicarum*. Indeed, the infestation of the ants in this strip of littoral at Ellisville is often so excessive that they resemble hedgehogs, fairly bristling with tufts of the fungus.

According to Thaxter, both *Rickia wasmanni* and *Laboulbenia formicarum* grow on all parts of their hosts, but this statement requires some qualification, at least in the case of the latter species. An examination of several hundred specimens of *L. neoniger* shows that the *Laboulbenia* grows most abundantly on the abdomen, middle and hind femora and tibiæ and posterior portions of the head. The thorax and coxæ, as a rule, are entirely free from the fungus;

the clypeus and gula are generally free, and this seems to be invariably the case with the mandibles, antennal funiculi, palpi, labium, maxillæ and eyes. In a very few specimens I have seen one or two of the little plants on the antennal scapes, but, as a rule, these organs are perfectly clean.

Heavily infested workers were seen toiling at their excavations, constructing the craters of the nest and running about as nimbly as uninfested individuals, but the colonies, judging from their rather limited personnel and the reduced number and small size of the craters seemed to be decidedly less prosperous than those of the larger, uninfested form of the same variety on the sandy beach. I excavated a considerable number of the nests of the infested colonies but in only one instance did I find larvæ, and I failed to find any queens, but as larvæ were not seen in the uninfested colonies and as the old queens of all of our species of *Lasius* are very rarely seen in the nests, these negative observations have little significance.

It is strange that this should be the first time in my rather extensive experience in collecting ants, that I have happened on a locality in which the colonies of a species are infested with Laboulbeniaceæ, and it is even more surprising that previous observers have found only two ant-infesting species of these fungi, which are represented by so many much larger and more remarkable forms on other insects. At first sight ants would seem to be particularly favorable hosts for such parasites since these insects are in the habit of huddling together in masses in warm subterranean galleries, where the fungi might be supposed to develop luxuriantly and transmit their spores from ant to ant with great facility. Further consideration of the matter, however, leads to the conclusion that other habits of the ants must, in all probability, tend to suppress or render impossible the development of the fungi, except under unusual conditions such as those in which I found the colonies of *L. neoniger* living at Ellisville. All ants devote a great deal of time and attention to cleaning their own integument and that of their nestmates. They are, indeed, forever combing and scraping the surfaces of their bodies with their tongues and strigils, so that fungi must find it difficult to gain a precarious foothold in their nests, to say nothing of an opportunity to proliferate. And even on

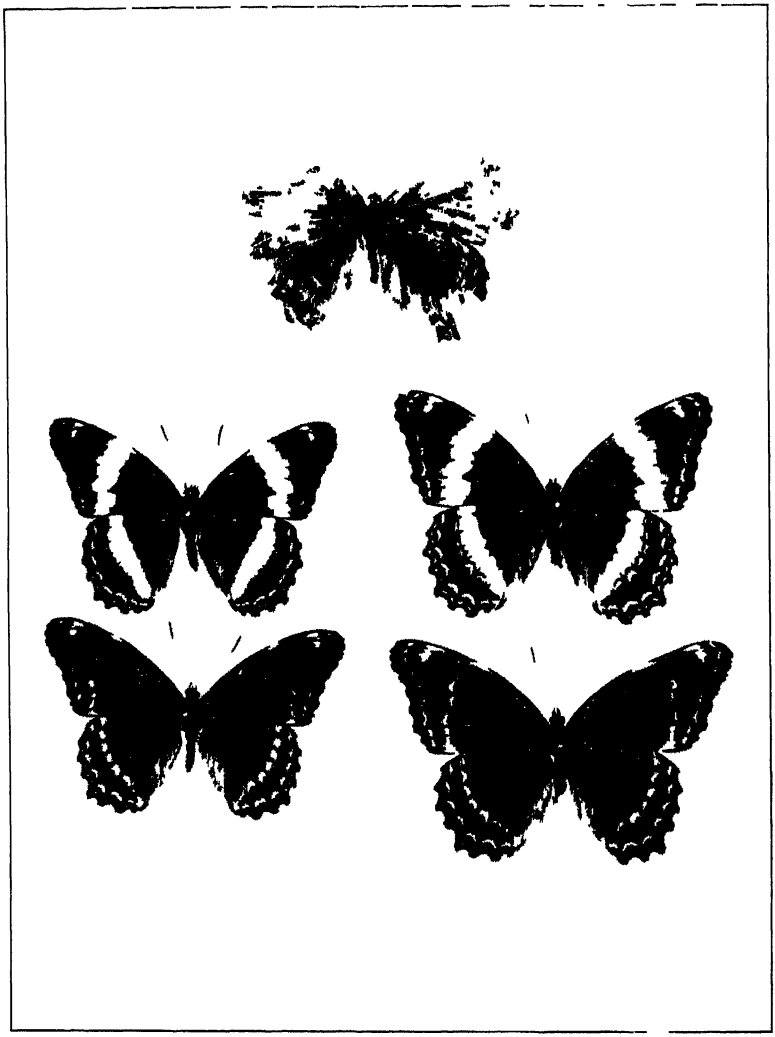
the rare occasions, when this happens, important organs like the mandibles, antennæ, labium, maxillæ, palpi and eyes are kept scrupulously free from the parasitic growth. Although, as previously stated, many of the *L. neoniger* bristled with the *Laboulbenia,* there were scattered over their chitinous integument numerous minute black dots representing the points of attachment of fungi that had been completely torn away, either by attrition against the walls of the nest galleries, or more probably, by the strigils and tongues of the ants themselves. The observations at Ellisville indicate that the parasitic fungus can luxuriate only on the members of ant-colonies which have become enfeebled or depauperate through nesting in soil which is too moist, saline or foul, or of an abnormally high temperature when exposed to the

ON THE REPUGNATORIAL SECRETION OF CARABUS VINCTUS.

A rather unexpected occurrence happened at the capture of my first specimen of this species, which I had discovered under some old boards near the Shawshine River in Andover, Mass. I picked it up between the thumb and finger for a closer examination and, when perhaps a foot from my face, heard a slight snapping noise which was followed by the sensation that might be produced by the application of red hot needles to one's face. This intense burning lasted until I bathed my face in alcohol. Since then I have taken two specimens in Framingham and, in each case, noticed the same snapping noise, but as I took good care not to get the insect very near my face, I did not experience the previous unpleasant results.

The elytral edges are strongly reflexed in this beetle and at the apices a slight hollow is formed which would hold a small quantity of the fluid secreted; and when the elytra receive the pressure of the thumb and finger they snap past each other and the resultant spring throws the fluid off in a fine spray.

C. A. Frost.



FIELD—BUTTERFLIES OF THE GENUS BASILARCHIA

THE OFFSPRING OF A CAPTURED FEMALE *BASILARCHIA PROSERPINA*.

By William L. W. Field,

Milton, Mass.

A female *Basilarchia proserpina*, taken at Springfield, Vt., August 14, 1908, refused to oviposit on the leaves of any available species of birch, poplar, or willow, but when furnished with wild cherry[1] leaves deposited thirty-one eggs, from sixteen of which offspring were reared to maturity. Of these offspring, nine (five males and four females) closely resembled the mother, and seven (four males and three females) were of the white-banded arthemis type, called by Edwards (1879) form *lamina*.

The accompanying plate shows the mother — much the worse for wear after her long captivity — and four of her offspring, a pair of each type. The entire series is now in the Museum of Comparative Zoölogy at Harvard University.

These observations, considered in the light of the Mendelian principles of heredity, give fresh support to the view of Scudder (1889) and others, who have believed *proserpina* to be a hybrid between *arthemis* and *astyanax*. The observed facts accord with those noted by Edwards, who in 1877 reared three *arthemis* and one *proserpina* from eggs deposited by a *proserpina* captured in the Catskill region; and in addition they bring out some new points:

First, the evidence of *proserpina's* hybridity furnished by her choice of an *astyanax* food-plant. In the opinion of collectors generally, the occurrence of a *Basilarchia* larva upon wild cherry plausibly identifies it as *astyanax;* and I find no record of the use of this food-plant by *arthemis*.

Second, some basis for a guess as to the specific identity of her mate. Springfield, Vt., is north of the zone in which *proserpina* ordinarily occurs, and it seems probable that the male parent of this diverse brood was of the *arthemis* (*lamina*) type.

Third, the approximately even division of the offspring between the two types, in a region where *proserpina* has heretofore been

[1] *Prunus serotina*.

unknown, while *arthemis* (*lamina*) is abundant, and always, so far as observation has shown, breeds true.

Edwards (1877, 1879) drew from his observations the conclusion that *arthemis* (*lamina*) and *proserpina* were to be referred to a single dimorphic species, flying in company with *astyanax* along the narrow zone where their ranges overlapped,— indeed dimorphic only in that zone,— yet never interbreeding with the other species. Mendel's work lay buried and forgotten; and no one realized that this dimorphism might under certain circumstances be a criterion of hybridity. The occurrence of other apparently hybrid Basilarchias (*astyanax-archippus* and *arthemis-archippus*) has been recorded (see Scudder, 1889, and Field, 1904), but its full meaning seems to have been overlooked. The cumulative significance of the various published observations of the genus Basilarchia in the eastern United States is contrary to Edwards's interpretation.

Our working hypothesis may now be that *proserpina* is a hybrid between *arthemis* and *astyanax*, in which the dark coloring of *astyanax* incompletely dominates the white band of *arthemis*.[1] In the narrow belt in which the hybrids commonly occur, these heterozygous individuals must often breed together, producing offspring of which 50 per cent. must resemble the parents (*i.e.*, are heterozygotes), while 25 per cent. are pure dominants (*astyanax*) and 25 per cent. are pure recessives (*arthemis*).[2] Farther north, where *astyanax* seems not to thrive, but the recessive white-banded *arthemis* holds sway, occasional stray examples of *proserpina*, mating with *arthemis*, will yield offspring of which 50 per cent. will be *proserpina* and 50 per cent. pure *arthemis*. In this division the Springfield brood probably belongs. South of the zone of hybridization, the white band must be almost swamped; for when *proserpina* mates with *astyanax*, the offspring will all be dark, and half of them will be pure dominants (*astyanax*). The occasional white-banded Basilarchias[3] taken on Long Island or in New Jersey, or in other places south of the usual range of *arthemis*, may be

[1] Such incomplete dominance is a widely-recognized phenomenon in Mendelian inheritance. See Bateson (1909) and Davenport (1910).

[2] The name *lamina* now appears to be superfluous, as we are assuming that there is but one form of *arthemis*.

[3] *Ursula* [=*astyanax*] var. *albofasciata* Newcomb (1907).

regarded as extracted recessives (*arthemis*), due to the interbreeding of southward-spreading heterozygotes (*proserpina*).

Moreover, wherever either *arthemis* or *astyanax* mingles with the widely-distributed *archippus*, we should look carefully for further evidences of hybridization involving that species.

Viewed thus, the Basilarchias of eastern North America constitute a group of unusual interest to students of organic evolution, and supply attractive material for experimental investigation.

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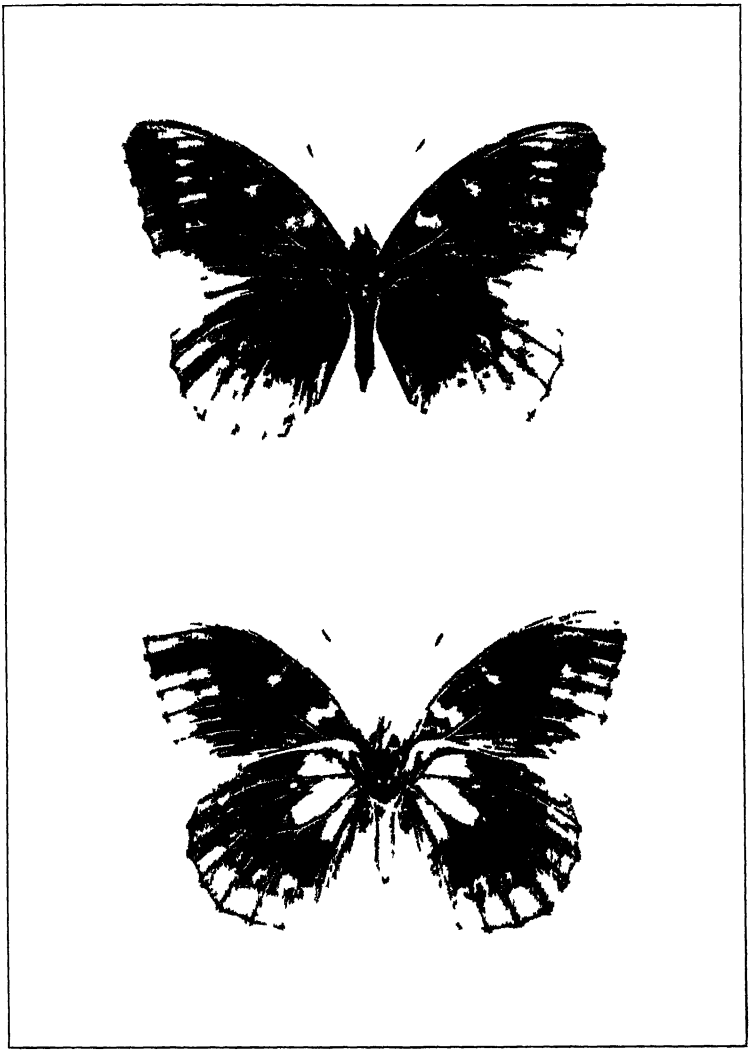
ARGYNNIS CYBELE FAB., VARIETY *BAAL*, STRECK. *MELANIC.*♀

By H. H. Newcomb,
Boston, Mass.

This handsome butterfly so well illustrated on the preceding plate was captured by Dr. S. Graenicher of the Public Museum, Milwaukee, on Aug. 1, 1909, at the junction of the Yellow and St. Croix Rivers, Burnett County, Wis. It was taken on the flowers of the common ox-eye daisy (*Rudbeckia hirta* L.). By comparison with photographs of two specimens of Strecker's *baal*, ♂, ♀, kindly sent me by Mr. F. J. V. Skiff, director of the Field Museum of Natural History at Chicago, it seems to correspond perfectly with those insects except for its melanism. On both sides the colors and shadings are those of *cybele* except for the intense blackness on certain areas as shown by the plate. The clustering of the three large silver spots at the base of the secondaries on the under side produce a marked and beautiful effect. It was my pleasure to see recently a *melanic cybele* ♀ in the collection of Mr. Joseph Mattes, New York City, and also a photograph of another sent me from the Field Museum, which Mr. W. J. Gerhard stated "is one of four specimens from Chicago," but these were quite distinct from the var. *baal* as shown here.

The above specimen is the property of the Public Museum, Milwaukee, and was taken during the collecting expedition sent out from there last summer.



NEWCOMB—ARGYNNIS CYBELE FABR VAR BAAL STRECK

SOME BEES OF THE GENUS *NOMADA* FROM WASHINGTON STATE.

By T. D. A. Cockerell.

The University of Colorado.

Nomada mutans sp. nov.

♀. Length about 7 mm.; black with creamy-white markings, and hardly any hair; anterior coxæ without spines; head and thorax strongly punctured; head broad, with the following light markings: lateral marks, broad below, with a little notch on each side near to black part of clypeus, extending upward above level of antennæ, ending in a rather obtuse point, a little away from orbital margin; lower two thirds of clypeus, the margin of the light area broadly angled in the middle above; labrum, but the lower half suffused with reddish; basal half of mandibles (apical half reddish); and narrow posterior orbits; mandibles simple; second joint of labial palpi much less than half length of first; scape blackish behind, reddish in front, with an obscure yellowish mark; flagellum thick, dark reddish above, light ferruginous below, first joint paler; third antennal joint conspicuously longer than fourth; mesothorax shining between the strong punctures; light markings of thorax as follows: upper margin of prothorax, tubercles, tegulæ, scutellum, postscutellum, and a triangular spot on anterior part of pleura; scutellum little elevated; wings dusky, stigma ferruginous, nervures fuscous; t. m. a short distance basad of b. n.; first r. n. reaching second s. m. well beyond middle; legs black, with creamy-white spots on hind coxæ, apices of femora and apices and bases of tibiæ; anterior legs light ferruginous in front; middle legs nearly the same; hind femora with a reddish stripe; anterior tarsi entirely pale reddish; spurs white; abdomen very minutely punctured, with five entire broad creamy-white bands, the first with a pair of spots; band of silver-white hair on fifth segment rather narrow; venter with light bands.

Var. a. Postscutellum all black; band on first abdominal segment without enclosed spots, but with a ferruginous notch on each side behind.

Var. b. Smaller, length about 5½ mm.; lateral marks not extending above antennæ; scutellum with two large light spots; postscutellum black; fourth and fifth abdominal bands broadly excavated in front on each side.

Hab.— Pullman, Washington State, 1908 (*W. M. Mann*). Two typical, Aug. 9; one var. a., Aug. 9; two var. b., Aug. 9 and 30. A

distinct little species, related to *N. verecunda* Cresson, but easily known by its creamy-white markings. The general appearance is suggestive of *N. viereckі* Ckll., but that has red legs. I wished to name this after its discoverer, but there is already a *Nomada manni* Morawitz.

Nomada semisuavis sp. nov.

♂. Length about 9 mm.; black and bright lemon yellow; the anterior coxæ with long spines; third antennal joint much longer than fourth; b. n. meeting t. m. Almost exactly like *N. suavis* Cresson, and possibly only a race or variety, but having the following distinctive characters: *Scape swollen;* lateral face-marks broader above; no black between lateral and supraclypeal marks; second s. m. narrower, receiving the first r. n. at its middle; yellow patch on pleura very large (fully twice as large as in *suavis*); legs seen from in front entirely yellow, anterior and middle femora with a black band behind, middle tibiæ with a black mark behind, hind femora almost entirely black behind, their tibiæ with a large black longitudinal band; last joint of hind tarsi bright ferruginous; *apical plate of abdomen strongly and sharply notched* (entire in *suavis*). *N. suavis* has been referred (Canad. Entom., 1905, p. 283) to *Holonomada,* but it belongs with the new species in the subgenus *Micronomada.* Both have in the male a pair of large yellow patches on the metathorax; Cresson's supposed male of *N. suavis,* without these marks, was probably *N. formula* Viereck.

Hab.—Wawawai, Washington State, July 4, 1908 (*W. M. Mann.*)

Nomada civilis spokanensis subsp. nov.

♀. Length about 11½ mm.; similar to the Corvallis, Oregon, form of *N. civilis,* but differing as follows: Scape wholly light red; tegulæ reddish (instead of yellow); mark on pleura suffused with red, and reduced, its posterior lobe obsolete or almost; yellow on scutellum reduced, with a median black line; metathoracic marks reddish, very small; yellow of legs mainly replaced by red; apical half of first abdominal segment red, with a small obscure yellowish spot on each extreme side; second and third segments very broadly red in the middle. The nervures and stigma are bright ferruginous, and the second submarginal cell has the characteristic broad form, with the r. n. joining it beyond the middle. (The venation indicates its relationship with *N. civilis,* and distinctness from the rather similar *N. vicinalis aldrichi* Ckll.)

Compared with the Colorado form of *N. civilis* it is still more distinct, being much larger, with the bases of the abdominal segments

broadly black, all the femora and tibiæ with large black patches behind, etc. In the table of Rocky Mountain species (Bull. 94, Colo. Exp. Sta.) it runs to 62, and runs out because it is a female with black thorax. The hair of the head and thorax above is strongly reddish. The b. n. goes a considerable distance basad of t. m.

Hab.— Spokane, Washington State, May 30 (*W. M. Mann*). Among the European species, this insect has a strong superficial resemblance to *N. ruficornis* (specimen from Buda compared).

Nomada malonella sp. nov.

♂. Length about 7 mm.; head and thorax black, densely and very coarsely punctured, with white hair, which is dull and scanty above, clear white and more abundant below, abundant and shining on lower part of face; head transversely suboval, face very broad, eyes converging below; lower corners of face, extreme lower margin of clypeus and base of mandibles yellow; mandibles simple, apical half ferruginous with the apex black or almost; labrum black, pallid around the margins; *scape stout, wholly black;* third antennal joint shorter than fourth, but more than half its length; flagellum long, rather thick, black above, broadly ferruginous beneath; area of metathorax rugose; *tegulæ dark ferruginous, coarsely rugosopunctate;* wings moderately dusky, the large stigma and nervures dark ferruginous; b. n. going far basad of t. m.; second s. m. broad above; legs red, the femora and tibiæ largely black behind, the posterior ones almost wholly so; hind tarsi largely blackened; spurs white; abdomen narrow, light but dullish red, with fine whitish pubescence giving it a silky appearance; first segment with the basal half black, the other segments a little blackened at extreme base; extreme side of segments 2 to 5, with successively smaller cream-colored spots; segments 4 to 6 with also subdorsal spots; venter with imperfect cream-colored bands, out of which large pieces seem to have been cut at the sides. Allied to *N. elegantula* Ckll. and somewhat to *N. melliventris* Cresson.

Hab.— Wawawai, Washington State, May 1, 1909 (*W. M. Mann*).

A female (date and locality the same) seems to belong here, but may represent another species. It is only about 6½ mm. long, and differs from the male thus: Scape with a red spot at base; third antennal joint almost as long as fourth; thorax with red marks as follows: upper border of prothorax, tubercles, two fine lines on mesothorax, two spots on scutellum, axillar spots, a line on postscutellum, a spot beneath wings, and a transverse mark on

lower part of pleura; also other minor details. There is a small red spot above each eye. The upper side of the abdomen agrees with that of *N. angelarum* Ckll.

Nomada malonina sp. nov.

♂. Length about 5¾ mm.; looks at first sight like a small example of *N. malonella*, but differs as follows: Flagellum proportionately shorter; lower margin of clypeus broadly yellow at sides; light parts of legs paler and suffused with yellowish; hind legs black except the knees, and apices of the other joints; t. m. a little basad of b. n.; scutellum less prominent; ground-color of abdomen light yellowish-red; first segment with more than basal half black, the edge of the black rather concave in the middle (projecting to form an angle in *malonella*); fourth and following segments dark with a subapical yellow band; sides of segments 2 to 4 with a broad oblique light yellow band, on 2 and 3 with a dark patch in front; ground color of venter dark, and light bands much broader. In both species the apical plate is strongly notched.

Hab.— Wawawai, Washington State, May 15, 1909 (*W. M. Mann*).

The following table separates the four related species. The venation of *N. melliventris* was kindly noted for me by Mr. Viereck, from Cresson's type.

Basal nervure going far basad of transversomedial.....1.
Basal nervure falling a little short of transversomedial.....2.

1. Tegulæ dark reddish; labrum black, except margins; scutellum prominent.....**malonella** ♂
Tegulæ yellowish; labrum yellow; scutellum not prominent, **melliventris** ♀

2. Scape with a large red basal patch in front; ground color of abdomen bright coppery-red.....**elegantula** ♀
Scape wholly black; ground color of abdomen pale yellowish-red **malonina** ♂

Nomada (Gnathias) perplexans sp. nov.

♂. Length about 9 mm.; head and thorax black, with long coarse white hair, which is slightly stained with yellowish above; lower corners of face sending a linear process along orbits nearly to level of antennæ, clypeus except sides above, labrum and basal half of mandibles, all light yellow; *scape entirely black;* flagellum red, the first five joints black above, the others with a blackish band; third antennal joint a little shorter than fourth; thorax densely and strongly punctured,

wholly black except the reddish tubercles; tegulæ very bright ferruginous; wings strongly dusky at apex; stigma ferruginous, nervures fusco-ferruginous; b. n. going far basad of t. m.; first r. n. joining second s. m. well beyond middle; legs red, the anterior femora black at base behind, the other femora with more black, the hind ones with more black than red; abdomen clear red, first segment with basal half and a pair of spots on apical half black; second segment with a pair of very large pale yellow patches, pointed mesad; sixth with a pair of obscure yellowish spots; apical plate notched; venter red with broad suffused blackish bands. A western representative of *N. perplexa* Cresson, easily distinguished by the much lighter red abdomen.

Hab.— Pullman, Washington State, June 7, 1908 (*W. M. Mann*).

Nomada itamera sp. nov.

♀. Length 8½ mm.; head and thorax coarsely rugosopunctate, with scanty white (yellowish dorsally) hair; black, with the following parts dark red, face below antennæ except a broad black band extending from each antenna to clypeal margin, mandibles (which are stout and blunt, but entire) entirely, labrum, posterior orbits extremely narrowly, a large triangular mark above each eye, a large V-shaped mark on each side of mesothorax, the greater part of the extremely prominent and strongly bilobed scutellum, upper border of prothorax, tubercles, and a very large patch on pleura; antennæ thick, third joint shorter than fourth, scape red in front, flagellum dark red suffused with dusky; tegulæ very bright ferruginous, strongly punctured; wings very dark on apical margin, stigma and nervures dark reddish; b. n. going a moderate distance basad of t. m.; second s. m. large, receiving first r. n. at middle; legs red, the femora with much black, the edges of the black suffused; abdomen broad, dark red, black at base of first segment trilobed, apical margin of first two segments strongly blackened; apical half of abdomen darker, with minute scattered glittering hairs; sides of second segment with a round suffused yellow spot; fourth segment with a pair of subdorsal yellow spots.

Hab.— Pullman, Washington State, May 30 (*W. M. Mann*). There is no sign of yellow at lower corners of face. A probable male of this species is from Wawawai, May 15.

Nomada orcusella sp. nov.

♀. Length 8⅓ mm.; bright ferruginous; head and thorax rugosopunctate; eyes reddish-grey; a keel between antennæ; the following parts are *black*, a large patch on front, including antennal sockets, a small area about ocelli; cheeks posteriorly, a median stripe on mesothorax, a

stripe on metathorax, area between wings and middle and hind legs, and region round tubercles; third antennal joint shorter than fourth; scape red; flagellum entirely red; scutellum bigibbous; tegulæ bright ferruginous, punctured; wings strongly dusky, with a hyaline area beyond submarginal cells; stigma dark ferruginous, nervures dark fuscous; b. n. going far basad of t. m.; first r. n. entering second s. m. much beyond middle; legs red, hind femora with much black, the others with some at base; hind basitarsus suffused with blackish; abdomen shining bright ferruginous, the segments not at all dark-margined, first segment black at extreme base and half-way along sides in second segment, with a large yellow spot on each side, third with very small spots; apical segments without yellow; venter without yellow. The mandibles are simple, and there is no yellow at lower corners of face.

Hab.— Orcus Island, Washington State, latter half of July, 1909 (*W. M. Mann*). The following table separates several females of *Nomada* s. str. described from Washington State:

Abdomen without yellow spots.....**kincaidiana** Ckll.
Abdomen with yellow spots, at least on second segment.....1.
1. Metathorax black, except for a couple of hardly visible red spots on enclosure; abdomen with scanty short silvery hairs, shining in certain lights.....**itamera** Ckll.
Metathorax red with a central black band; abdomen without shining silvery hairs.....2.
2. Abdomen deep chestnut red; wings darker.....**orcusella** Ckll.
Abdomen light red.....**flammigera** Ckll.

The Nomadæ of Washington State were listed and tabulated by Viereck in Canadian Entomologist, Aug. 1905. A collection received from Mr. W. M. Mann contains not only the new forms described above, but also several others new to the state, so it will be worth while to give a new list, complete to date. I have omitted from it some males of *Nomada* s. str., which probably belong with females already described, but cannot be certainly associated with them at present.

Gnathias.

This group differs from all the others in having bidentate mandibles.

(1.) *N. perbella* Viereck. Hoquiam (*Burke*, fide Viereck); Olympia and Seattle (*Kincaid*, fide Viereck); Wawawai, May 1, both sexes (*Mann*); Pullman, May (*Mann*).

Mr. Mann's specimens have the abdomen dark red, and agree with Viereck's description in both sexes. On this basis, the species seems valid; but the Kincaidian specimens, which I formerly (Proc. Acad. Nat. Sci. Phila., 1903, p. 601) referred to *N. bella* Cresson, have the female paler than in typical *bella*, and do not seem to be *perbella*. More collecting is needed to determine whether there are really two species.

(2.) *N. perplexans*, n. sp. Pullman (*Mann*).

(3.) *N. cuneata* Robertson. Pullman, May (*Mann*). This is not quite typical; from a single specimen I cannot determine whether there is a distinct northwestern race.

(4.) *N. grayi eastonensis* Ckll. Easton.

(5.) *N. washingtoni* Ckll.

Nomada s. str. (Robertson.)

Like *Gnathias* but with simple mandibles.

(6.) *N. flammigera* Ckll. N. Yakima (*Jenne*); see Ann. and Mag. Nat. Hist., July, 1906, p. 71.

(7.) *N. cressoni trevoriana* Ckll. Olympia (*Kincaid*).

(8.) *N. kincaidiana* Ckll.

(9.) *N. itamera* n. sp. Pullman (*Mann*).

(10.) *N. orcusella* n. sp. Orcus I. (*Mann*).

(11.) *N. malonella* n. sp. Wawawai (*Mann*).

(12.) *N. malonina* n. sp. Wawawai (*Mann*).

(13.) *N. packardiella* Ckll., var. a. Mesothorax with three black stripes; a large yellow patch on fifth abdominal segment. Pullman, May 14, 1909 (*Mann*).

(14.) *N. pulsatillæ* Ckll., var. a. Silvery apical lunule on abdomen larger. Pullman, May 2, Spokane, May 30, and Wawawai, May 1 (*Mann*).

(15.) *N. vicinalis aldrichi* Ckll. Spokane, May 30 (*Mann*).

Xanthidium.

(16.) *N. citrina* Cresson.

(17.) *N. rivalis* Cresson.

(18.) *N. civilis* Cresson. Males with scutellum all dark. Wawawai, April 24 to May 15, and Pullman, May 20 (*Mann*).

(19.) *N. civilis spokanensis* n. subsp. Spokane (*Mann*).

(20.) *N. modocorum* Ckll. Spokane, May 30 (*Mann*).

(21.) *N. coquilletti* Ckll. Wawawai, March and April (*Mann*).

The characters originally given to separate *N. coquilletti* from *N. modocorum* are not constant; the Washington State specimens separate as follows:

(a.) Abdomen red, yellow and black; tegulæ red; scutellum with two red spots; metathorax without spots; legs red and black.
(a.) Larger (and with other differences) *N. vicinalis aldrichi*
(b.) Smaller.....*N. modocorum*
(b.) Abdomen black and yellow, with a little reddish; legs yellow, red and black; tegulæ yellow, at least in part; scutellum, postscutellum and metathorax black.....*N. coquilletti* ♂

(22.) *N. pascoensis* Ckll. Pasco (*Kincaid*); Wawawai, May 15 (*Mann*).

(23.) *N. jennei* Ckll. N. Yakima (*Jenne*). Not a true *Xanthidium;* there is apparent affinity with *Micronomada;* see Canad. Entom., 1906, p. 282.

Holonomada.

(24.) *N. hesperia* Ckll. Pullman, May 15 and 23, 1909 (*Mann*). One is much smaller than the other.

(25.) *N. edwardsii* Cresson. Pullman, June 1 (*Mann*).

(26.) *N. vinnula* Cresson. Spokane, May 20, Wawawai, May 15, and Pullman, May 23 (*Mann*).

(27.) *N. mutans* n. sp. Pullman (*Mann*).

Micronomada.

(28.) *N. semisuavis* n. sp. Wawawai (*Mann*).

Nomadula.

(29.) *N. articulata* Smith. Pullman, May 28 (*Mann*).

(30.) *N. erythrochroa* Ckll. Pasco (*Kincaid*); N. Yakima, June (*Jenne*).

SOME NEUROPTERA FROM AUSTRALIA.

By Nathan Banks,

East Falls Church, Va.

From Professor Perkins of Hawaii, and Mr. Dodd of Kuranda, Queensland, I have received a number of Australian Neuroptera. The Chrysopidæ and a few other forms are described in this article. There are four genera of Chrysopidæ in Australia; *Chrysopa, Nothochrysa, Ankylopteryx,* and *Apochrysa.* The first two occur in the United States, but *Nothochrysa* only in California. As with us *Chrysopa* is the largest genus, and some of the species are very similar to some of our forms.

Chrysopa.

The Australian forms known to me can be distinguished by the following table:

1. Dark marks on the vertex.....C. ramburi
   No marks on the vertex.....2.
2. Veins all green.....6.
   Veins partly black.....3.
3. A black spot on the radial sector, shortly before the stigma C. signatipennis
   No such spot.....4.
4. Many veins more or less margined with dark.....5.
   Veins not margined.....C. innotata
5. A band across the face.....C. irregularis
   No band across face.....C. regularis
6. Basal part of antennæ blackish.....7.
   Antennæ all pale.....8.
7. Vertex mostly red, face reddish.....C. atalotis
   Vertex yellowish, a transverse red stripe over base of antennæ from eye to eye.....C. satilota
8. Divisory veinlet commonly ending before the cross vein; wings long, slender, acute.....C. otalatis
   Divisory veinlet ending beyond the cross vein.....9.
9. Larger species; stigma indistinct, vertex reddish; wings very narrow C. italotis
   Medium species, stigma not very distinct; vertex pale; wings quite broad.....C. latotalis
   Smaller species, a reddish spot on vertex, stigma of hind wings very prominent.....C. olatatis

Chrysopa signatipennis sp. nov.

Pale yellowish; antennæ slender, pale, basal joint large and long, compared with the size of the head; pronotum longer than broad, narrowed in front, and each side with a dark spot; abdomen dark toward tip. Wings with mostly pale venation, the gradate series slightly darker; there is in each fore wing a very prominent black spot on the radial sector between the sixth and seventh cross-vein from sector to radius; the stigma is scarcely distinct. Wings rather slender, slightly acute at tip, the costal area much broader than the third cubital cell, latter twice as long as broad, the divisory veinlet ends just beyond the cross-vein; about seven veinlets in outer gradate series, six in the inner, the outer series quite remote from the margin. There are four cross-veins between radius and subcosta beneath stigma; hind wings not very much narrower than the fore pair. Expanse 25 mm.

From North Queensland (Perkins).

Chrysopa regularis sp. nov.

Pale yellowish; basal joint of antennæ with two reddish-brown lines on the outer side; pronotum very short, and narrower than the vertex. Wings with longitudinal veins mostly yellowish, transverse veinlets mostly black, and partly bordered with faint brown; the branches of the radial sector are also brown, and margined; stigma short, dark; in hind wings the venation mostly pale, but costals dark. Wings rather short, blunt; costal area plainly broader than third cubital cell, divisory veinlet ending far beyond the cross-vein, four veinlets in each gradate series, only four branches of radial sector, only twelve costals before stigma, between subcosta and radius, below the stigma, are four cross-veins; hind wings narrow, more acute, only four branches to radial sector, latter at base united to median for much more than a cell length. Expanse 18 to 20 mm.

From Middle Queensland (Perkins).

Chrysopa irregularis sp. nov.

Pale yellowish, a transverse red band across face below antennæ from eye to eye, a red spot on each cheek, and a red stripe above on basal joint of the antennæ; pronotum short and broad, broader than the vertex. Wings with mostly pale venation, very faintly bordered with brown, darker on some dark veins near base of costa, near stigma, at tip of wings, near end of anal vein, and at middle of hind margin, stigma dark; hind wings with pale venation, except at end of anal vein. Fore wings moderately long, almost acute at tip, costal area much broader than the long third cubital cell, the divisory veinlet ends just beyond the cross-vein, about three gradate veins in inner series, and four or five in outer; near tip of wing is a

diamond-shaped cell formed by the last fork of radius bending up near to radius, and connected thereto by a very short cross-vein; five branches of radial sector, about sixteen costals before stigma. Hind wings narrow, and much shorter than fore wings, the radial sector at base connected to median by less than a cell length. Expanse 24 mm.

From North Queensland (Perkins).

Chrysopa olatatis sp. nov.

Pale greenish; antennæ yellowish, a reddish spot behind on the vertex; pronotum green, with a broad pale median stripe, thorax and abdomen also greenish, with median dorsal pale reddish stripe. The abdomen rather short, pronotum much broader than long; wings unmarked, but the stigma of the hind pair very prominent and reddish brown. Wings short, but acute at tip, costal area barely broader than the third cubital cell, latter hardly twice as long as broad, divisory veinlet ending beyond the cross-vein; five veinlets in each gradate series, and four between subcosta and radius beneath the stigma. The hind wings not much narrower than the front pair; venation all pale green. Expanse 21 mm.

From Port Darwin, 4 Sept. (Dodd).

Chrysopa italotis sp. nov.

Pale yellowish, vertex slightly reddish; antennæ wholly pale yellowish; pronotum nearly twice as broad as long, green, with pale median stripe; thorax and abdomen pale. Wings unmarked, stigma indistinct. The wings long and narrow, acute at tip, the costal area barely broader than the third cubital cell, the latter long, with base uneven, divisory veinlet ending beyond cross-vein; eight gradate veinlets in the outer series, five or six in the inner series; about six cross-veins between radius and subcosta beneath stigma; in the hind wings the radial sector unites with the median for about a cell-length; venation all pale yellowish. Expanse 34 mm.

From Port Darwin, 19 March (Dodd).

Chrysopa latotalis sp. nov.

Pale yellowish throughout, unmarked, unless checks are rather rufous, and a faint paler stripe on middle of pronotum. Pronotum much broader than long, with transverse groove behind the middle; apex of male abdomen from side obliquely truncate, longer above. Wings of moderate size, broad and blunt at tips; costal area a little broader than the third cubital cell, base of latter not oblique, divisory veinlet ending beyond the cross-vein; about seven gradate veinlets in outer series, and five in inner series; below stigma three or four cross-veins between radius and subcosta; the stigma in both

pairs of wings rather prominent; in hind wings the radial sector is united to the median for much less than a cell-length. Expanse 28 mm.

From Kuranda (Dodd), and North and Middle Queensland (Perkins).

Chrysopa atalotis sp. nov.

Vertex, face and most of basal joints of the antennæ reddish, basal part of antennæ black; pronotum longer than broad, narrowed in front, green, with a pale median stripe; thorax yellowish; abdomen brownish green; legs pale. Wings hyaline; venation greenish, costa, subcosta and the radius more yellowish, stigma moderately prominent, yellowish. Wings rather large, hardly acute at tip; costal area no wider than the third cubital cell, base of this cell very oblique, the divisory veinlet ending beyond the cross-vein, about eight or ten veinlets in the outer gradate series, and four in the inner series; beneath the stigma there are about six cross-veins between radius and subcosta; in the hind wings the radial sector is united to median for the length of a cell. Expanse 32 to 35 mm.

From Port Darwin, January, April (Dodd).

Chrysopa satilota sp. nov.

Head pale yellowish, a deep red stripe from eye to eye, just above the antennæ; basal joint of antennæ large, yellowish, beyond the antennæ are brownish, but paler toward tips; pronotum longer than broad, narrowed in front, greenish, with pale median stripe; thorax and abdomen yellowish; legs very pale, darker on tarsi; tip of male abdomen, seen from the side, deeply incised in middle. Wings hyaline, rather large, acute at tips; costal area hardly broader than the third cubital cell, base of this cell scarcely oblique, divisory veinlet ending beyond the cross-vein; about eight veinlets in the outer gradate series, and five in the inner; below the stigma four or five cross-veins between subcosta and radius; all venation very pale greenish, unmarked. Expanse 31 mm.

From Port Darwin, 1 May (Dodd).

Chrysopa otalatis sp. nov.

Pale yellowish or greenish throughout, no markings, but the cheeks are more or less rufous, and there is sometimes on the thorax a trace of a paler median stripe; the venation is all pale yellowish, unmarked. The pronotum is as broad as long, but little narrowed in front, usually with a transverse ridge near the middle; the tip of male abdomen, seen from the side, is deeply incised, but the upper part projects farther than the lower. The wings are very slender, acute at tip, but the costal area is fully as broad as the third cubital cell, the latter is very long, the divisory veinlet

ending before the cross-vein; about seven veinlets in each gradate series; below the stigma about four cross-veins between subcosta and radius; the stigma not especially prominent; in hind wings the radial sector unites to the median for more than a cell-length. Expanse 28 mm.

From Brisbane, and Bundaberg district, Queensland (Perkins).

Nothochrysa.

In all the Australian species the middle veinlet connecting anal to cubitus in the fore wings is much nearer to the outer than to the inner veinlet. The four species known to me are separable as follows:

1. A black spot between bases of antennæ, and two dark spots on vertex ..... **N. tripunctata** M'Lach.
   No spot between antennæ ..... 2.
2. A dark band across face below antennæ, pronotum and thorax marked with black ..... **N. facialis** Bks.
   No marks on face ..... 3.
3. Marks each side on pronotum; divisory veinlet of third cubital cell dark ..... **N. insignis** Walk.
   No marks on pronotum; divisory veinlet of third cubital cell pale ..... **N. lata** Bks.

Nothochrysa facialis sp. nov.

Pale yellowish; a transverse black band across the face below the antennæ, rest of head unmarked; antennæ brown, except basal and second joints; pronotum with a rather broad, elongate, black spot on each side, two prominent black spots on middle lobe of mesonotum, a spot along anterior border of the lateral lobes, three small dots on lateral lobes of metathorax, and a narrow band across basal segment of abdomen, rest of abdomen with some black spots; a few dark spots on the mesosternum. Wings with pale veins, the cross-veins nearly all black, likewise most of the radial sector, also the divisory veinlet; stigma not very dark. Wings elongate, slender, acute at tip, costal area scarcely as broad as third cubital cell, the divisory veinlet slightly oblique; about eight veinlets in the outer gradate series and seven in the inner; in the hind wings the outer part of radial sector, outer cross-veins, and gradate veinlets are black. Expanse 30 mm.

From Port Darwin, 27 March (Dodd).

Nothochrysa lata sp. nov.

Pale yellowish throughout; pronotum extremely broad, about three times as broad as long; thorax very large. Wings elongate, but not acute at

tip, venation mostly pale, the gradate series black, and many other veins, especially cross-veins, black at base and tip. Costal area not as broad as third cubital cell, the latter rather short, the divisory veinlet slightly oblique; eight gradate veinlets in the inner series, nine in the outer series; in hind wings the venation is almost wholly pale. Expanse 40 mm.

From Port Darwin, 29 August (Dodd).

Ankylopteryx pallida sp. nov.

Pale yellowish throughout, the palpi marked with dark at the tip, and on each anterior corner of pronotum is a dark spot; wings pale, some of the cross-veins and gradate series faintly dark, but a more distinct spot on the radius at the point where it is joined by the first cross-vein from the radial sector; costal area at origin of radial sector is nearly as broad as rest of the wing at that point, the radial sector very sinuous, emitting six or seven branches; the third cubital cell nearly twice as long as broad, the divisory veinlet cutting off a small cell, but ending beyond the cross-vein; near tip of wing the subcosta diverges from the radius, between radial sector and median are four cross-veins; hind wings much narrower, acute venation pale. Pronotum slightly longer than broad, narrowed a little in front. Expanse 24 mm.

From North Queensland (Perkins). *A. immaculata*, described from Tasmania, has a spot over antennæ, distinct stigma, etc.

Myiodactylus pubescens sp. nov.

Pale yellowish; sides of pronotum faintly greenish, a black dot on each anterior lobe of the mesothorax; antennæ near middle barely darker; wings with only a few cross-veins in middle area black and black at forkings of some of the costals, and those along apical margin. Antennæ barely more than one third the length of the wings; pronotum slender, narrowed in front, a furrow before the middle, and a swollen ring at the posterior margin. Wings extremely broad, not two and a half times as long as broad, a few of costals forked near middle, all near tip, as likewise all around apical and outer margin; radial sector with nine branches, the connecting veinlets numerous, about one in every three or four black, the cells mostly broader than long; entire surface of fore wings and also the costa densely hairy, mostly erect, especially prominent near anterior base; hind wings much less hairy, one half narrower, the radial sector with eight branches, and nearly all veins unmarked. Expanse 40 to 44 mm.

From Port Darwin, 18 March, 14 April (Dodd).

Mantispa pullula sp. nov.

Pale yellowish; a median brown stripe on the face; antennæ dark; pronotum slender, on enlarged part in front with brown sides and two submedian brown stripes; thorax pale, dark on lateral lobes; femur of leg I dark brown on inner side, middle and hind coxæ obliquely barred with

brown. Wings hyaline, with red-brown stigma. In general similar to *M. imbecilla*, but much smaller, only 7 to 9 millimeters to tip of wings, and the stigma of wings is still shorter than in that species, and more swollen on the costal side.

From Port Darwin, 10 Sept. (Dodd), apparently common.

WET WEATHER COLLECTING.

Until June 23, 1906, collecting lepidoptera had been associated in my mind with fairly pleasant days or nights, but on that date I started out on a misty forenoon with a beating net intending to look only for coleoptera. Promising logs and fungi led me into a thick growth of large hemlocks, pines, and firs, with scattered hard woods of several species, where several moths brought to mind the request of a friend for Geometridæ. After four hours work, the last of which was in a pouring rain, I retreated with eighty-five specimens representing the genera *Heterophleps, Tephroclystis* (*Eupithecia*), *Mesoleuca, Hydriomena, Euchœca, Sciagraphia, Macaria, Homochlodes, Melanolophia, Æthaloptera, Anagoga, Gonodontis, Caberodes, Sabulodes,* and *Xanthotype* of the Geometridæ; *Pyrophila, Homoptera,* and some of the so-called Deltoids, besides some genera of the families of the Platypterygidæ, Pyralididæ, Tortricidæ, and Œcophoridæ.

Many of the specimens were taken on the sheltered side of the tree trunks, on the under side of lodged dead ones, and on the sides of old logs. They were flushed from the tops of live evergreens, from thickets of dead tops and brush, by throwing clubs and stones into them, from whence they would flutter away to the ground or to some nearby tree, where they were sometimes easily bottled. Again, some exciting net and foot work would be necessary, and I found that a heavy beating net — soaking wet, too,— is not the best thing for flying moths. I also discovered that thumps and kicks against the smaller trees would often bring down, besides the water, a number of species not otherwise seen. About 2.30 p. m., my clothing became so thoroughly soaked and the net had to be wrung out so often that it became too disagreeable even for an entomologist. I have never seen the Geometridæ so plentiful as they were during that season at Monmouth, and Wales, Maine, which may, in a measure, account for my success on such a day.

C. A. Frost.

A NEW SPECIES OF TELENOMUS PARASITIC ON THE EGGS OF TUSSOCK MOTHS.

By Charles T. Brues.[1]

The present species belonging to the very extensive Scelionid genus *Telenomus* was reared from eggs of two species of Tussock moths and sent to me by Mr. W. F. Fiske, in charge of the Gypsy Moth parasitological laboratory of the U. S. Bureau of Entomology at Melrose Highlands, Mass. It appears to be new to science and as Mr. Fiske wishes to refer to it in a forthcoming publication, he has requested me to prepare the description which is herewith presented.

Telenomus fiskei sp. nov.

♀Length 1 mm. Shining black; the legs, except coxæ, honey yellow or brownish-yellow, the femora piceous or fuscous; wings hyaline. Head nearly four times as wide as thick antero-posteriorly. Ocelli in a curved line, the lateral ones removed from the eye margin by less than their own diameter. Head margined behind the eyes, the raised margin extending over the vertex as a distinct carina for about a third the distance toward the median line; behind this the occiput is margined, more distinctly so on the sides. Vertex shagreened; the front below the ocelli smooth, and highly polished, but with a shagreened sculpture on the sides below. Antennæ black; 10-jointed, with a 5-jointed club. Scape brownish at base and apex, reaching nearly to the vertex; pedicel brownish at the tip, fully twice as long as thick at the apex; first flagellar joint fully as long as the pedicel and as thick; second shorter, two thirds as long, the fourth broader and more rounded; first four club-joints large, quadrate, equal; last a trifle longer, and sharply conically pointed. Thorax as wide as long, very convex in front, shining above, but thinly covered with a white pubescence. No trace of parapsidal furrows. Mesonotum and scutellum very faintly shagreened. Postscutellum finely rugulose-punctate. Abdomen short, sessile, about as long as the thorax, first segment coarsely longitudinally striated, four times as broad as long at the middle; longer at the sides, and with a large fovea at each anterior angle; second segment with a basal series of longitudinal striæ as long as those on the first segment medially, but becoming shorter toward the sides; about one third longer than wide; following segments each very short, together scarcely over one

[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 21.

third the length of the second. Wings hyaline, the venation pale yellowish brown, marginal vein rather short, one half the length of the stigmal.

Male. Differs from the female by its paler antennæ, which have the scape and pedicel pale brownish yellow and the flagellum fuscous; pedicel subtriangular, two thirds the length of the first flagellar joint, which is equal to the second; third and fourth growing shorter; fifth to ninth moniliform, broader; last twice as long as the penultimate, gradually pointed.

Described from ten specimens from Machias, Maine, August 20, 1909, Cambridge, Mass., August 3, 1907, and Brooklyn, N. Y., June, 1900. The Maine specimens were reared by Mr. C. W. Johnson from the egg-mass of *Notolophus* on spruce; those from Cambridge, Mass., from egg-masses of *Hemerocampa leucostigma;* and those from Brooklyn were reared by Mr. Theo. Pergande from *Hemerocampa leucostigma.*

This is a most remarkable species in having the antennæ of the female ten instead of eleven jointed, but it is so typically a *Telenomus* in all other respects, that I have refrained from separating it. So far no other members of this tribe have been described as having only ten antennal joints.

THE CHALCIDOID PARASITES OF THE COMMON HOUSE OR TYPHOID FLY (*MUSCA DOMESTICA* LINN.) AND ITS ALLIES.[1]

II. Reconstruction of the Genus *Pachycrepoideus* Ashmead of the Family Pteromalidae, with Description of *P. Dubius* Ashmead, Sp. Nov., Its Type Species.

By A. A. Girault and George Ethelbert Sanders,

The University of Illinois.

Introduction.

This second of the series of papers on the chalcidoid parasites of the house fly and its allies considers a monotypical genus which occurred but rarely in connection with its host. We met with it but four or five times during the course of our rearing work and are not perfectly sure as to its rôle as a parasite. The tribe to which it belongs is composed of genera supposed to be mostly hyperparasitic, but at the present state of our knowledge of the host relations of the group, this is no reason for classing the genus as the same. Our records lead us to believe that it attacks *Musca domestica* as a primary parasite, with the possible alternative of being secondary, its host *Muscidifurax raptor* Girault and Sanders MS.[2] or one of the species of *Spalangia*, also to be considered later.

History and Description of the Genus.

In a table of the genera of the Sphegigasterine tribe Pachyneurini published in 1904, Ashmead, in his memoir on the classification of the chalcid flies, briefly described the genus under consideration, merely naming the species *Pachycrepoideus dubius* Ashmead as type, without describing the species or even indicating that it was new to science. The genus was proposed as follows:

"*Table of Genera.*

1. Females 2
   Males 7
2. Mesothoracic furrows distinct, complete.....3
   Mesothoracic furrows incomplete, indicated only anteriorly.....4

[1] Continued from Vol. XVII, p. 28.

[2] Described in the third paper of this series.

3. Stigmal vein with a large knob; abdomen ovate, pointed at apex, the second segment large, the third segment very short, the fourth and fifth rather large, sub-equal, the following very short.
Pachycrepis Förster (type *Caruna clavata* Walk.)
Stigmal vein with a small knob; abdomen ovate, the second and third segments large, the fourth and fifth very short, the sixth and seventh longer.
Pachycrepoideus Ashmead, g. nov. (type *P. dubius* Ashm.)
4. Abdomen above flat or depressed.....5
Abdomen above convexly rounded.....6
5." Etc., p. 329.

Extracting, the genus was described thus, including both sexes: Pteromalids with the abdomen distinctly petiolate; fore wings with the marginal vein not especially long but thick and stout; cephalic aspect of head short and rounded, the occipital line incomplete; antennæ inserted on or near the middle of the face, far above the clypeus; mesothoracic furrows distinct, complete; stigmal vein with a small knob; abdomen ovate, the second and third segments large, the fourth and fifth very short, the sixth and seventh longer.

It is only through the kindness of Mr. J. C. Crawford of the United States National Museum, who compared our specimens with the single type specimen of the genus, that we were able to establish their identity. The existing codes of nomenclature do not clearly cover this case. As a matter of principle, we are greatly opposed to accepting genera belonging to this class, especially those of recent description, believing them to be obstructions; the species is a *nomen nudum,* for in this case it is obvious that the generic description does not include the species or have reference to any specific characters; it cannot be, therefore, in any sense an indication, definition, or description for the species. Hence, it is our opinion that all genera and species of this class are without status in nomenclature, the many opinions and the codes to the contrary notwithstanding. Accepting this fact, the genus *Pachycrepoideus* and its type species is subject to arbitrary treatment at the hands of the first systematist who happens to deal with it. We have nothing to do here with so-called credit or with courtesy, but solely with expediency and nomenclatorial science, which is impersonal. So we protest, not against this genus alone, but against all of the genera of its class, irrespective of authorship; as we protested

against *Nasonia* Ashmead in the first paper of this series. At the present day, the formation of genera in this manner is both obstructive and inexcusable; it should be prevented.

Recognizing expediency alone in this case, we are of the opinion that both the generic and the specific name should be retained on the basis of reconstruction and that in order to avoid confusion, the

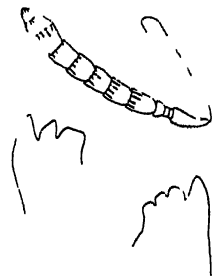


Fig. 1. Antenna of *Pachycrepoideus dubius* Ashm., and right and left mandibles showing dentition.

original author of the names should be cited. We therefore retain the name *Pachycrepoideus dubius* Ashmead with the single female specimen, upon which the genus was founded as type.

GENUS PACHYCREPOIDEUS ASHMEAD.

Type: *P. dubius* Ashmead sp. nov.

Female. Normal in size and aspect for the tribe; submetallic, reticulated. Head (cephalic aspect) circularly triangular, slightly wider than long; clypeus slightly wider than long, its apical margin slightly emarginate at the meson, the whole margin trisinuate; dorsal aspect, head wider than the thorax, the vertex broad and rounded, the occipital margin broadly concave but the vertex not noticeably narrowed at the meson, the ocelli in a flat triangle in the center of the vertex, distant from the margin of the eyes; latral aspect, genæ rounded, as long as the rounded-ovate eyes, the genal sulcus absent. Antennæ inserted about two thirds down the face, slightly ventrad of an imaginary line drawn between the ventral ends of the eyes, the flagellum clavate; antennæ 13-jointed, with three ring-joints (see fig.) and a 3-jointed club, the pedicel long, distinctly longer than the moderately long first funicle joint (Fig. 1).

Pronotum distinct, transverse, narrower than the mesothorax; parapsidal

furrows distinct, complete; axillæ widely separated, extending mesad to the parapsidal furrows; scutellum normal, rounded; metathorax moderate in length, shorter than the scutellum, declivous, the pro- and mesonotum flat, the metanotum punctate, with complete lateral carinæ, without spiracular sulci and with no true median carina but with a distinct, subacute rotundity at its base medially; its spiracle moderately large, subreniform; no metathoracic neck. Abdomen with a moderate petiole, variable in shape, usually ovate and depressed, concave dorsad, flatly convex ventrad, with a slight ridge along the venter at the meson; rarely compressed and conic-ovate, flat dorsad, very convex ventrad but not long; second and third abdominal segments large, united forming about half the length of the abdomen (excluding petiole), the fourth and fifth segments subequal, much smaller; abdomen about equal in length to the thorax.

Wings normal, hyaline, the short and broad marginal vein subequal to the clavate stigmal vein and a fourth shorter than the narrow post-marginal vein; hind wings uniformly ciliate discally. Knob of stigmal vein small.

Tarsi 5-jointed, all tibial spurs single. Mandibles 3 and 4-dentate (Fig. 2). Maxillary palpi 4-jointed, the distal joint largest, labial palpi 3-jointed, the middle joint smallest, the others subequal.

Male. The same, but the antennæ are cylindrical and inserted nearer to the middle of the face, the genal sulcus present, the abdomen obconic and depressed and more or less truncate at the caudal end.

The genus cannot be confused with any other of the tribe Pachyneurini, excepting *Pachycrepis* Förster, the complete, distinct mesothoracic furrows distinguishing it. From *Pachycrepis* it differs in the smaller stigmal knob and the abdominal characters brought out in the quoted portion of Ashmead's table given previously.

No locality for the type species has been recorded in the literature, but the single type specimen now in the United States National Museum formerly bore the number 602 of C. F. Baker, Agricultural College, Michigan. We have found it only at Champaign, Illinois.

Our knowledge concerning the host relations of the genus is too scanty for positive statement. As shown on a later page, the single species was reared always in connection with *Musca domestica,* and in four of the six rearing records it was definitely connected with that host of which it appears to be a primary parasite. *Muscidifurax* Girault and Sanders MS. and *Spalangia* Latreille are common primary parasites of the house fly, and in one instance each was

reared in numbers in connection with this species from the same host lot. In several of the host puparia in other lots from which *P. dubius* emerged (single specimens) there was found in each the blackened, compact meconium of the parasite, somewhat similar to that of *Spalangia* and *Muscidifurax*, as well as the remains of a pupa of *Musca*, which fact indicates primary parasitism. The evidence available, therefore, points to *Musca domestica* as the host of this species, which we consider as a solitary, external parasite with habits similar to those of *Muscidifurax* and *Spalangia*.

Pachycrepoideus dubius Ashm. sp. nov.

Ashmead, Mem. Carnegie Mus., I, pp. 329, 383 (1904).

Female. Length variable, 1.15–2.10 mm. Normal for the tribe. General color nigroæneous, black with slight æneous reflections, submetallic but in bright sunlight metallic dark-greenish, the abdomen smooth and shining, polished black, like surface of tar, the head and thorax closely reticulated or confluently punctate, reflective, somewhat glossy and sparsely hispid; antennæ concolorous but not metallic, the scape, pedicel and first two ring-joints variable, usually fuscous, the pedicel dusky dorsad; coxæ concolorous, the cephalic and intermediate coxæ more diluted in color, the posterior coxæ metallic; legs variable, uniformly fuscous, with the apical tarsal joint dusky or black, or else fuscous with more or less blackish in the dorsal aspect of the femur or the whole femur distinctly darker than the following joints; tegulæ fuscous; wings hyaline, venation neutral black, the marginal vein conspicuous. Eyes inconspicuous in color, dark garnet, the middle longitudinal third much darker, forming a dark median longitudinal stripe; ocelli liquid pinkish. Venter concolorous. Clothing of body inconspicuous.

(Cephalic aspect) head sub-circular, circularly triangular, slightly wider than long, face with a median impression along the scrobes, the scapes lying side by side in the impression and extending not quite to the cephalic margin of the vertex or to the dorsal apex of the eyes and less near to the cephalic ocellus; clypeus slightly wider than long, slightly emarginate at the meson of its apical (ventral) margin, its basal or proximal (dorsal) margin slightly convex, its sutures obsolete, but the whole sclerite slightly impressed and finely, longitudinally striate; antennæ inserted nearly two thirds down (ventrad) the face, slightly below (ventrad) an imaginary line drawn between the ventral ends of the eyes, but not especially near the clypeus, being slightly more the distance above (dorsad) that sclerite as the latter is long at the median line; (lateral aspect) genal sulcus absent; the cheeks rounded and as long as the length of the eyes; the latter rounded-ovate, longer than wide, with sparse, minute setæ, practically naked, their

surface about equal in roughness to the general sculpture of the head; face declivous ventrad from the insertion of the antennæ; (dorsal aspect) head twice wider than long, wider than the greatest width of the thorax, the vertex broad, its cephalic margin straight and rounded, the occipital margin rounded, concavely curved, the visible portions of the margins of the eyes regularly convex, entire; portions of the head caudad of the eyes narrow but not acute or sharp; lateral ocelli narrow or linear-ovate, the cephalic ocellus circular; each lateral ocellus slightly farther from the respective eye margin than from the cephalic ocellus and a third farther apart from each other than each is from the cephalic ocellus. Occipital foraminal impression rounded.

(Dorsal aspect) pronotum visible, distinct, not as wide as the mesonotum and about a fourth its length, not narrowed at the meson, its margins straight and rounded, obtuse; pro- and mesonotum practically flat, slightly convex (lateral aspect, viewed in outline), the thorax declivous at the mesopostscutellum; parapsidal furrows distinct, complete, narrow, convexly curved; cephalic margin of the mesoscutum straight, its caudal margin broadly convex; axillæ, with their mesal apices or angles, reaching to the base of the respective parapsidal furrow, the suture separating them from the scutellum widening caudad and with a few transverse ridges; scutellum broadly rounded caudad, nearly as long as the mesoscutum, with a faint cross-furrow before apex; mesopostscutellum narrow; metathorax moderate in length, not quite as long as the scutellum, declivous, punctate, bicarinate, without a spiracular sulcus, the spiracle moderately large, subreniform (linear and slightly curved), lying in an oblique position and with its cephalo-mesal end near the lateral carina and not distant from the mesopostscutellum; disk of the metathorax, or portion included between the lateral carinæ, produced farther caudad than the lateral portions of the segment, its lateral angles subacute; neck absent; folds or lateral carinæ distinct, complete, running caudo-mesad in a gently curving line; median carina absent, but at the base of the metathorax at the meson and against the mesopostscutellum is a distinct, subacute rotundity, best seen from the direct lateral aspect. Thorax moderately, confluently punctate, or coarsely reticulated, the sculpture slightly coarser than that of the head, and still more coarse on the disk of the metanotum. Thoracic pleura similarly sculptured, as are also the posterior coxæ; anterior coxæ reticulated, the intermediate coxæ nearly smooth.

Abdomen distinctly petiolate, the petiole moderate in length; the tip of the ovipositor slightly exserted; ventral valves inconspicuous; segments two and three subequal, long, the second longer, both taken together occupying half the surface, the fourth and fifth segments subequal, short, each about a half the length of either the second or third segments; caudal margins of the second and third segments in the dorsal aspect straight, in the lateral aspect curved convexly and in the ventral aspect bilobed, incised at the meson; remaining abdominal segments inconspicuous, the apical segment acute. Wings normal for the tribe, that portion of the fore wing distad

e submarginal vein closely ciliate, the remaining proximal part mostly
l, the marginal cilia of fore wing short and close, absent proximad on
margins; marginal vein abnormally broadened as in *Pachyneuron*
er, conspicuous, about thrice the width of the postmarginal vein, short
road, about the length of the stigmal vein and about a fourth shorter
the slender postmarginal vein; submarginal vein narrow, widening
stal sixth at its curve before joining the marginal vein and more
four times longer than the latter, much slenderer and bearing about
a large bristles from its surface; stigmal vein shorter than the post-
nal vein, straight, clavate, and with a small uncus, its knob or club
ct but not formed abruptly; postmarginal vein long and slender, uni-
in width, distinctly longer than either the marginal or stigmal veins,
about a fourth longer than either; marginal cilia of the costal margin
wing beginning at the proximal end of the marginal vein; fore wing
ly rounded at the apex, the wing being widest at a point slightly
of the end of the postmarginal vein; several spurious veins present.
wings uniformly, but not densely, ciliate on the disk, the submarginal
xtending to the hooklets; the costal cell irregular in shape, dilated
middle, the submarginal vein consisting of a moderately broad proxi-
alf, confluent, or nearly, with the costal margin, then an abrupt nar-
ortion not as long as the proximal thickened half and curving caudad
from the costal margin, the costal cell distinct and moderately broad
t point, and finally a third, short curved part distad, as broad as
oximal half and curved latero-cephalad to join the marginal
t the hooklets and uniform in width with the marginal vein; sub-
al vein about one and a half times longer than the marginal vein;
or wings broadest at a point just distad of the apical end of the
al vein, that is to say, a short distance distad of the proximal half
wing; apex subacute; marginal cilia longer, sparser, longest on the
margin of the distal half or third of the wing. Tarsi 5-jointed, the
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nnæ consisting of a scape, pedicel, three ring-joints, five funicle
nd three club joints; funicle and club hispid-pubescent, the flagel-
gularly clavate, the club not abruptly formed or much larger or
han the funicle. Scape long, cylindrical, slightly tapering distad,
ian half the length of the flagellum and longer than the funicle,
l in length to the united length of the pedicel, three ring-joints
first three funicle joints; pedicel obconic, conspicuously longer than
d ring-joint and equal in length to it and the first funicle joint
d; the two proximal ring-joints distinct, equal, combined slightly
han the third ring-joint, the latter abruptly smaller than the first
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its, and not bare like them, but only a third the length of the fol-
oint and about a fourth the length of the pedicel, wider than long;
joints cylindrical, but gradually becoming shorter, so that the

fourth and fifth are subquadrate and subequal, the second and third subequal, longer than wide and the first the longest joint of the funicle, about a third longer than the fourth or fifth; the basal joint of the club subquadrate but slightly longer and wider than the fourth or fifth funicle joints; the intermediate joint wider than long, and the apical joint obtusely conical, slightly larger than the third ring-joint; but a single row of hispid hairs on each joint of the funicle and club, in balsam mounts of antennæ appearing as white longitudinal ridges (Fig. 1).

Mandibles 3- (left) and 4-dentate (right), in the former case, the inner mesal tooth is truncate and shortest, the two others acute, the lateral tooth longest; in the latter case, the three inner (mesal) teeth small, obtuse and subequal, the lateral outer tooth much longer, obtusely conic (Fig. 2).

From fourteen specimens.

Male. Length, variable, averaging 1.60 mm. The same, more æneous metallic, the sculpture coarser, the body more slender, the antennæ pilose-pubescent, inserted nearer to the middle of the face, distinctly above (dorsad) of an imaginary line drawn between the ventral ends of the eyes, but not half way up the eye margins, the face more convex; antennal scrobes deep, margined, running vertically nearly to the cephalic ocellus and nearly confluent at the meson, the medial impression not as noticeable as in the female; genal sulcus present, but very faint, narrow; the abdomen more distinctly petiolate and depressed, obconic, broadly truncate caudad, the second segment longest, covering two thirds of the surface, the abdomen widest at its apex, the third segment about a half shorter and the remaining ones hidden within; genitalia exserted in death; abdomen, including the petiole, not quite as long as the thorax, slightly concave dorsad, slightly convex ventrad; petiole not coarsely rugose.

Antennæ the same in general, but more slender, the flagellum cylindrical; club somewhat narrower than the funicle, the scape slightly curved, not tapering distad, cylindrical, not as long in proportion to the flagellum, less than half its length and not quite as long as the funicle; pedicel large but not as long as the united lengths of the third ring-joint and first funicle joint; the proximal ring-joint smaller than the intermediate one; all funicle joints longer than wide and subequal; the third ring-joint is subquadrate, yet longer than wide and about half the length of any one of the funicle joints and longer than the united lengths of the two proximal ring-joints; first funicle joint not noticeably longer than the fifth; club cylindrical, its first two joints subequal, longer than wide, somewhat shorter than funicle five, the apical joint conical, a fourth shorter than the basal joints. At least three rows of pilose hairs on funicle joints one to five and the three club joints and two rows on the third ring-joint; a few short hairs on the dorsal aspect of the pedicel, the two proximal ring-joints and scape naked.

Mandibles as in the female; the distal joint of the maxillary palpi twice longer than any of the three remaining joints, which are all subequal and

of the submarginal vein closely ciliate, the remaining proximal part mostly naked, the marginal cilia of fore wing short and close, absent proximad on both margins; marginal vein abnormally broadened as in *Pachyneuron* Walker, conspicuous, about thrice the width of the postmarginal vein, short and broad, about the length of the stigmal vein and about a fourth shorter than the slender postmarginal vein; submarginal vein narrow, widening at distal sixth at its curve before joining the marginal vein and more than four times longer than the latter, much slenderer and bearing about fifteen large bristles from its surface; stigmal vein shorter than the postmarginal vein, straight, clavate, and with a small uncus, its knob or club distinct but not formed abruptly; postmarginal vein long and slender, uniform in width, distinctly longer than either the marginal or stigmal veins, being about a fourth longer than either; marginal cilia of the costal margin of the wing beginning at the proximal end of the marginal vein; fore wing broadly rounded at the apex, the wing being widest at a point slightly distad of the end of the postmarginal vein; several spurious veins present. Hind wings uniformly, but not densely, ciliate on the disk, the submarginal vein extending to the hooklets; the costal cell irregular in shape, dilated in the middle, the submarginal vein consisting of a moderately broad proximal half, confluent, or nearly, with the costal margin, then an abrupt narrow portion not as long as the proximal thickened half and curving caudad away from the costal margin, the costal cell distinct and moderately broad at that point, and finally a third, short curved part distad, as broad as the proximal half and curved latero-cephalad to join the marginal vein at the hooklets and uniform in width with the marginal vein; submarginal vein about one and a half times longer than the marginal vein; posterior wings broadest at a point just distad of the apical end of the marginal vein, that is to say, a short distance distad of the proximal half of the wing; apex subacute; marginal cilia longer, sparser, longest on the caudal margin of the distal half or third of the wing. Tarsi 5-jointed, the tibial spurs all single.

Antennæ consisting of a scape, pedicel, three ring-joints, five funicle joints and three club joints; funicle and club hispid-pubescent, the flagellum regularly clavate, the club not abruptly formed or much larger or wider than the funicle. Scape long, cylindrical, slightly tapering distad, more than half the length of the flagellum and longer than the funicle, subequal in length to the united length of the pedicel, three ring-joints and the first three funicle joints; pedicel obconic, conspicuously longer than the third ring-joint and equal in length to it and the first funicle joint combined; the two proximal ring-joints distinct, equal, combined slightly longer than the third ring-joint, the latter abruptly smaller than the first funicle joint, a large ring-joint, nearly twice the size of either of the other ring-joints, and not bare like them, but only a third the length of the following joint and about a fourth the length of the pedicel, wider than long; funicle joints cylindrical, but gradually becoming shorter, so that the

fourth and fifth are subquadrate and subequal, the second and third subequal, longer than wide and the first the longest joint of the funicle, about a third longer than the fourth or fifth; the basal joint of the club subquadrate but slightly longer and wider than the fourth or fifth funicle joints; the intermediate joint wider than long, and the apical joint obtusely conical, slightly larger than the third ring-joint; but a single row of hispid hairs on each joint of the funicle and club, in balsam mounts of antennæ appearing as white longitudinal ridges (Fig. 1).

Mandibles 3- (left) and 4-dentate (right), in the former case, the inner mesal tooth is truncate and shortest, the two others acute, the lateral tooth longest; in the latter case, the three inner (mesal) teeth small, obtuse and subequal, the lateral outer tooth much longer, obtusely conic (Fig. 2).

From fourteen specimens.

Male. Length, variable, averaging 1.60 mm. The same, more æneous metallic, the sculpture coarser, the body more slender, the antennæ pilose-pubescent, inserted nearer to the middle of the face, distinctly above (dorsad) of an imaginary line drawn between the ventral ends of the eyes, but not half way up the eye margins, the face more convex; antennal scrobes deep, margined, running vertically nearly to the cephalic ocellus and nearly confluent at the meson, the medial impression not as noticeable as in the female; genal sulcus present, but very faint, narrow; the abdomen more distinctly petiolate and depressed, obconic, broadly truncate caudad, the second segment longest, covering two thirds of the surface, the abdomen widest at its apex, the third segment about a half shorter and the remaining ones hidden within; genitalia exserted in death; abdomen, including the petiole, not quite as long as the thorax, slightly concave dorsad, slightly convex ventrad; petiole not coarsely rugose.

Antennæ the same in general, but more slender, the flagellum cylindrical; club somewhat narrower than the funicle, the scape slightly curved, not tapering distad, cylindrical, not as long in proportion to the flagellum, less than half its length and not quite as long as the funicle; pedicel large but not as long as the united lengths of the third ring-joint and first funicle joint; the proximal ring-joint smaller than the intermediate one; all funicle joints longer than wide and subequal; the third ring-joint is subquadrate, yet longer than wide and about half the length of any one of the funicle joints and longer than the united lengths of the two proximal ring-joints; first funicle joint not noticeably longer than the fifth; club cylindrical, its first two joints subequal, longer than wide, somewhat shorter than funicle five, the apical joint conical, a fourth shorter than the basal joints. At least three rows of pilose hairs on funicle joints one to five and the three club joints and two rows on the third ring-joint; a few short hairs on the dorsal aspect of the pedicel, the two proximal ring-joints and scape naked.

Mandibles as in the female; the distal joint of the maxillary palpi twice longer than any of the three remaining joints, which are all subequal and

moderately short; the distal joint of the maxillary palpi clavate and hairy at its tips.

Described from eight males and fourteen females, unless otherwise stated, now in the collections of the Illinois State Laboratory of Natural History, Urbana, Illinois, and reared in the insectary of the office of the State Entomologist of Illinois, at Urbana during the late summer of 1908, from the following experiments: (1) One female appeared Sept. 11, 1908, in company with two females of *Nasonia brevicornis* Ashmead from decomposed chicken entrails infested with dipterous maggots, taken from the city dumping grounds, Champaign, August 22, 1908; from these viscera were obtained *Chrysomyia macellaria* (Fabricius), Sept. 7, *Calliphora erythrocephala* (Meigen), Sept. 11, and *Sarcophaga* sp. "K,"[1] Sept. 22. (Accession No. 41003, 1 ♀ tagmounted; ♀ head in xylol-balsam); (2) One female appeared Sept. 3 from a cage containing maggots in decomposed watermelons from the same place, and from which were reared a *Drosophila,* August 30 to Sept. 17, and *Musca domestica,* September 1. (Accession No. 39808, 1 ♀ tagmounted.) (3) On Sept. 10, a number of Pteromalids were collected from the cages in which muscid and other dipterous larvæ were breeding and confined separately in capsules each with a single puparium of *Musca domestica.* One of these Pteromalids proved to be a female of *P. dubius* [2] which was observed to oviposit into the host puparium on Sept. 10. The resulting progeny proved to be a single female which was found on the fifth of the following October. (Accession No. 40177, 1♀ tagmounted, ♀head in xylol-balsam). (4) Five males and nine females appeared October 24 or previously from a cage containing a quantity of puparia of *Musca domestica* reared from the maggots collected in horse manure, Sept. 20, in a manure box in Urbana, and then left until Sept. 30 exposed in the insectary where they were evidently parasitized. On the latter date, each puparium was isolated in a capsule, and from these capsules were taken the nine females and five males; other pteromalids, *Muscidifurax* and *Spalangia,* were very abundant. (Accession No. 40253, 4♂'s, 9♀'s tagmounted; ♂ head in xylol-balsam. Remaining ♂,

[1] New species; designated thus for convenience.
[2] Homotype in U. S. National Museum collection.

homotype in U. S. N. M.) (5) One male appeared on October 2 in company with a number of *Muscidifurax* from a large lot of puparia of *Musca domestica* reared from maggots in horse manure and exposed to parasites for three days, Sept. 8–11. On Sept. 17, the host puparia were isolated in gelatine capsules and from one of these puparia the male emerged. The puparium contained the host pupa in fragments and the single, large meconium of the parasite. (Accession No. 40171, 1♂ tagmounted). (6) Nine days later, October 11, from each of these isolated puparia of the same lot (*Musca domestica*) there emerged two males and one female. Both *Spalangia* and *Muscidifurax* were very common in this experiment. (Accession No. 40206, 2♂'s, 1♀ on tags).

The characteristics of this species are the blackish æneous color, the generally uniformly fuscous legs, the concolorous coxæ, the generally fuscous scape, pedicel, and basal ring-joints, the remainder of the antennæ being neutral in color or nearly concolorous with the body, the polished abdomen and uniform sculpture of the thorax, the position and shape of the ocelli and the hyaline wings.

Among the thousands of Chalcidoid, mostly pteromalid, parasites reared from muscid and other Dipterous larvæ during the course of breeding experiments with the house fly during the latter part of the season of 1908 this species occurred very rarely as recorded in the foregoing.

Type: — Type No. 12260, United States National Museum, Washington, D. C., 1 ♀, tagmounted (C. F. Baker). *Homotypes:*— 1♂, 1♀ in the same collection, Urbana, Illinois, both tagmounted.

Nothing is known concerning the biology of this genus. The adults emerge (three cases) from the host puparium through a single circular hole with jagged edges but so far we know of no characteristic distinguishing these emergence holes from those of *Spalengia* or *Muscidifurax*. The meconium is a single dark compact mass circular in outline, but is not very characteristic and beggars description.

PROCEEDINGS OF THE CAMBRIDGE ENTOMOLOGICAL CLUB.

The 291st regular meeting of the club was held on Tuesday evening, December 21, 1909, with President Bolster in the chair, and with sixteen members and one visitor present.

Mr. Emerton, reporting for the Committee on the Smoker, said that preparations for two hundred visitors had been made, the smoker to be held at the Grundmann Studios, 198 Clarendon Street, Tuesday evening, December 28, from 8 p. m. Mr. Field reported the list of contributors to the exhibition and the preparation for the dedication of the Harris tablet at Milton on Friday, December 31, at 12.30 p. m. President Bolster reported the result of the meeting of the Executive and Publication Committee: the resignation of Mr. Field as editor of PSYCHE, and the hope that Mr. Brues would be able to undertake the work. Mr. Brues, being called upon by the chair, replied that he would try to manage things so that he could take up the work. The president appointed the following nominating committee to prepare a list of officers for the club for the ensuing year: Messrs. Blackburn, Reiff and Newcomb. Mr. Fiske was appointed delegate to represent the club at the eighth International Zoological Congress at Graz, Austria, in August of 1910. Dr. A. L. Reagh was elected member of the club.

Mr. Johnson exhibited a box of unique larvæ from several sources; a nymph, possibly of a may fly, from Ammonoosuc River, Fabyans, N. H., taken by C. H. Frost September 19, 1909; larvæ of *Galerita janus*, and what was pronounced by Professor Wheeler as being probably a female *Phengodes* from Providence, R. I.

He also exhibited two boxes of Diptera of the family Dolichopodidæ which has recently claimed his attention. He mentioned some new records for New England and said he had recognized 127 species from these states.

Mr. Forbes spoke of his studies of the larval stages of the Lepidoptera and requested specimens from the members.

C. A. FROST, *Secretary.*

The 292nd regular and the 33rd annual meeting since incorporation was held at the rooms of the Appalachian Mountain Club on Tuesday evening, January 18, 1910. There were ten members present: President Bolster and Messrs. Blackburn, Brues, Emerton, Frost, Newcomb, Reiff, Sheriff, Swett, and Timberlake.

After the reports of the Secreatry and Treasurer had been read the following officers were elected for the ensuing year:

President—Prof. W. M. Wheeler.
Vice President—W. F. Fiske.

Secretary—C. A. Frost.
Treasurer—F. A. Sheriff.
Executive Committee—J. H. Emerton, C. W. Johnson, P. G. Bolster.
Editor-in-Chief of PSYCHE—C. T. Brues.

The retiring President, Mr. P. G. Bolster, then gave the address: "Remarks on the History of the Cambridge Entomological club."

Materials for this paper were gathered from the records of the club and proved to be of great interest. Mr. J. H. Emerton, who attended many of the earlier meetings and who was one of the original organizers of the club added some recollections to Mr. Bolster's remarks. The progress of the club was reviewed from the first meeting at the home of Dr. Hagen at Cambridge down to the present date in so far as the records were available. Lists of the officers of the club, addresses of the retiring presidents, and much other data of historical interest were given. Mention was also made of the number of prominent entomologists throughout the country who have, at one time or another, been members of the club. Mr. Bolster closed his remarks by recommending that an index of the records be made for the valuable and interesting data that appear in them.

C. A. FROST, *Secretary.*

Meeting called to order by President W. M. Wheeler at 8 o'clock. Twenty members and two visitors present.

The Secretary being absent, Mr. H. S. Smith was appointed to act as Secretary *pro tem.*

Mr. Fiske gave a talk on "Hypermetamorphosis among Insects." The various types of hypermetamorphosis as defined and designated by Packard and as encountered in the work at the Gipsy Moth Parasite Laboratory were not at all analogous to each other Mr. Fiske stated. These phenomena fall distinctly into two groups, the one typified by that type of hypermetamorphosis occurring in certain beetles (Rhipiphoridæ, Meloeidæ) and the Hymenopterous genera *Perilampus* and *Orasema*, the other typified by that form of development occurring in certain Proctotrypids (*Inostemma, Platygaster*) and most of the Ichneumonids (*Ophion, Theronia, Limneria, Ichneumon*). The former he designated as Incomplete Hypermetamorphosis and the latter type as Complete Hypermetamorphosis.

The president asked Mr. Fiske to take the chair while he read a review of "A Monographic Revision of the Twisted-Winged Insects of the Order Strepsiptera Kirby" by W. Dwight Pierce. This paper was discussed by Messrs. Brues, Johnson, Fiske and others.

Mr. Newcomb exhibited some interesting photographs of hybrids and variations in the butterfly genus *Basilarchia*. He also showed an interesting melanistic specimen of *Argynnis cybele* from northern Wisconsin. Mr.

Reiff remarked on the work of certain European investigators upon the phenomenon of melanism in the genus *Argynnis* as occurring in Europe.

Mr. Emerton gave his report of the committee on the smoker given at the time of the meeting of the American Association for the Advancement of Science.

Mr. Bruce made some remarks on the new form given to PSYCHE and stated that the forthcoming number would be in the regular octavo size instead of the royal octavo as heretofore. He asked especially for short notes and papers for publication.

The following persons were proposed for membership in the club:

Mrs. R. L. Draper, Canton, Mass.

Dr. J. S. Kingsley, professor of zoölogy in Tufts College.

Dr. Wheeler stated that certain rooms at the Bussey Institution were being remodeled and repaired and it was hoped that future meetings of the club might be there. It was moved and seconded that the next meeting of the club be held in these rooms. Carried.

HARRY S. SMITH,
Secretary pro tem.

The 291th regular meeting of the club was held at the Bussey Institution, Forest Hills, Tuesday evening, March 15, with 17 members and three visitors president, and President Wheeler in the chair. The minutes of the January and also the February meetings were read and accepted.

It was voted that extracts from the minutes of the meetings be published regularly in PSYCHE.

Mrs. R. L. Draper of Canton, Mass., and Dr. J. S. Kingsley, professor of zoölogy in Tufts College, were elected to membership. Mr. C. E. Montgomery, 338 Boylston Street, Boston, was proposed for membership by C. W. Johnson and W. L. W. Field. The resignation of R. W. Harris of Melrose was accepted. Mr. J. H. Emerton's paper on "Some Cases of Dimorphism in Spiders" was then presented with blackboard sketches; drawings, made with his usual care and accuracy, and alcoholic specimens of the species under discussion were also handed around. The following cases were described: 1. The females of *Misumena vatia* and *Misumena aleataria* may be either white or yellow. 2. Males of *Mavia vittata* have one form with spotted legs and colors like the female and another with white legs and the rest of the body black. 3. *Agræca pratensis* and *Agræca repens* are probably one species with one kind of male and females with two different forms of the epigynum. Females found at the same time and place have both forms. 4. *Ceratinella latabilis* has two forms of male palpus, one with a short tibia with a wide tooth and a smooth edge to the tarsus. The other with a narrower tibia and tooth half as wide and the edge of the tarsus with two ridges.

Mr. C. W. Johnson spoke on the so-called "Ground Pearls," *Margarodes formicarium* of the West Indies. The specimens shown are formed by

the female nymphs in which they are encysted and often remain a long period. They are very common on newly cleared land. Heavy rains carry immense numbers to the shore, where they are frequently gathered with sea-shells and often strung as beads for necklaces, etc. This species was described by Guilding (Trans. Linn. Soc., London, 1833, p. 115, pl. 1) as a parasite of ants, but it is probable that their relation to the ants is similar to that of other Coccidæ. A species *M. vitum*, is described by Mayet (Ann. Soc. Ent. France, 1896. p. 419) as infesting the roots of the vines in Chili. Prof. Wheeler called attention to a new species of *Margarodes* recently described from southern Europe.

Mr. Johnson referred to a recent paper by Prof. Stein (Wiener Ent. Zeitschr, XXIX p. 11, 1910) on the genus *Fucellia*. A study of all the material at hand from Labrador to Florida, shows only one species, referable to *F. marina* Macq. and not to *F. fucorum* Fallén.

Prof. A. P. Morse gave a paper on "A Hopperdozer for Rough Ground." This was illustrated by drawings of the apparatus which is designed to catch young grasshoppers when they are destructively prevalent as they are at times in New England and where the ground is so rough that any other device of this kind is useless. His suggestion that the plates be covered with "tanglefoot" used for banding trees was discussed by the members.

Mr. Newcomb reported the occurrence of a noctuid moth flying on March 3rd. Dr. Reagh said that he had seen three moths flying on Feb. 22, and on the eighth of March took a specimen of *Phygalia titea*. Mr. Swett remarked on the records of the captures of *Phygalia olivacearia* and said that its occurrence seems to be limited to a few days about March 31st. Mr. Emerton showed two early spring insects, *Chionea valga*, a Tipulid fly with vestigial wings, found on snow at Three Mile Island, Lake Winnipesaukee, N. H., Feb. 21, 1910, and *Capnia pygmæa*, a Neuropteriod insect on snow at Jackson, N. H., Feb. 21.

The meeting then adjourned to the laboratory, where refreshments were enjoyed by all, through the kindness of Prof. Wheeler.

C. A. Frost, *Secretary*.

REVIEWS.

Wheeler, William Morton. Ants, Their Structure, Development and Behavior. 830 pp. XXV+663, figs. 286. New York, 1910, Columbia University Press. The MacMillan Co. $5.00.

It is very rarely that the available literature of entomology has been so enriched by a single contribution as by Professor Wheeler's book on ants, for until its appearance, the general reader, and even the student of entomology, has had no place to go for an accurate digest of the facts relating to this most interesting and important group of insects. The author's extensive contributions to myrmecology during the past decade have rendered him peculiarly fit to undertake this difficult task of presenting the subject both in its zoölogical and psychological aspects, since a very considerable part of the book deals with his own investigations, hitherto scattered, like the other literature of the subject, in a large number of scientific journals.

The subject matter is presented under three main divisions: structure, development and behavior. The last of these occupies by far the larger part of the book, representing the aspect of greatest interest at the present time, as well as the one into which the author's research has principally led him.

There are very complete accounts of the external and internal structure of ants, preceded by an introductory chapter on "Ants as dominant insects." The presentation of their development is supplemented by an extensive chapter of the complicated phenomena of polymorphism and its causes. Following these are chapters on the history of myrmecology and the classification of ants, their geographical distribution, and a summary of the present knowledge concerning fossil ants.

Introducing the chapters on ethological topics is an account of the habits of ants in general and their various types of nests. Following these are taken up the habits of a number of circumscribed groups, each of which illustrates a characteristic mode of life. These are: the Ponerine ants, the driver and legionary ants, the harvesting ants, the fungus-growing ants and the honey ants. Together with these is a chapter on the relations of ants to vascular plants, and following them three chapters on myrmecophilous insects.

A consideration of the compound nests of ants introduces the matter relating to parasitic and slave-making ants which is very full and complete. The last three chapters on the sensations of ants, the instinctive behavior of ants and the plastic behavior of ants deal with the fascinating psychological aspects of myrmecology.

The large series of illustrations are uniformly excellent, and with several appendices on methods, classification, economic importance, and literature, add much to the usefulness of the book.

C. T. Brues.

Code des Couleurs, à l'usage des Naturalistes, Artistes, Commerçants et Industriels. 720 Echantillons de Couleurs classés d' après la méthode Chevreul simplifiée. par Paul Klincksieck, et Th. Valette, Paris. (1908). G. E. Stechert, New York City, Agent.

This is a book of 32 pages of text, and 50 plates, containing 720 blocked colors; a table of ten principal colors in eighteen languages, and a table of contents; the whole making a neat and portable volume. The publication of this book is a great boon to systematic naturalists everywhere, as Ridgway's Nomenclature of Colors for Naturalists, has been out of print for some time, and it has been practically impossible to obtain a copy of it. This book was planned in 1906, through a real need felt in the study and description of Mushrooms; thus it was planned, in part, by a naturalist for naturalists. The hope is expressed that this color code may recommend itself universally, and there is certainly great need of a uniform nomenclature of colors, accepted and used by naturalists everywhere. As the recognition of geographic isolation as a factor in evolution comes to be better known and studied, it is imperative that a close study be made of minute differences in form and color, in order to understand the probable evolution of species or subspecies.

The fundamental colors are six, those of the solar spectrum, and the tones are indicated by a number, the method devised by Chevreul; which is decidedly better than "Se fatiguer pour trouver dans les trois Règnes ou ailleurs le nom d'un équivalent qui lui ressemble plus ou moins vaguement," and "qui ne signifient rien de précis." Every hundred numbers is equivalent to one of the colors of the solar spectrum.

Part II is by Th. Valette, and considers the following subjects:

1. Des couleurs au point de vue physique.
2. Sources de lumière.—Lumières colorées.
3. Des couleurs matérielles ou pigments colorés.
4. Classification des couleurs.
5. Code des Couleurs à l'usage des naturalistes.
6. Confection du Code des Couleurs.
7. Examen des couleurs complémentaires contrastes.

The book ought to be in use by every naturalist, dealing with groups which exhibit color differences, thus helping toward a uniform nomenclature, instead of indicating a color by some vague term, which leaves an idea of uncertainty. Stability in terminology ought to be as important as the rules of nomenclature,—priority, etc., and should be taken up by committees on nomenclature.

Fordyce Grinnell, Jr.

Needham, James G. General Biology; a book of outlines for the general student. pp. xiv; 512, figs. 287. Ithaca, N. Y. 1910, The Comstock Pub. Co. Price $2.00.

Entomologists will be much gratified to see the wide extent to which Professor Needham has drawn upon insects to furnish the material for illustrating many of the biological topics treated in this book. It is intended to serve as a guide for the One-year course in biology as given in most colleges where the work is divided between zoology and botany, but the two are not kept separate in the present outline which aims to give a general idea of the broader principles of the evolution, adaption and interrelationship of organisms, rather than the specific morphological studies usually presented to students of this class. Such a presentation should prove attractive to the young college student, particularly if combined with a really enthusiastic teacher.

C. T. Brues.

The Fungus Gnats of North America. By O. A. Johannsen. Bull. 172, Maine Agric. Exp. Sta., pp. 209–276, pls. 3 (March 1910).

This very valuable contribution to American dipterology deals with about half of the North American Mycetophilidæ, a family which has been in great need of revision for many years. Eight subfamilies are recognized of which five, the Bolitophilinæ, Mycetobiinæ, Diadocidinæ, Ceroplatinæ and Macrocerinæ are considered in the present paper. Seventy-one species are recognized and described, belonging to a number of genera, the largest, *Platyura*, having 26 species referred to it.

C. T. Brues.

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OBSERVATIONS ON THE EARLY STAGES OF TWO APHIDIINE PARASITES OF APHIDS.

By P. H. Timberlake,

Bureau of Entomology, Washington, D. C.

A few weeks ago some cocoons of Praon were discovered on a rose-bush brought to the Gypsy Moth Parasite Laboratory from a local greenhouse, and at the suggestion of Mr. W. F. Fiske, the opportunity was seized of making a brief study of the early stages of this common parasite of aphids.

Accordingly a small number of the cocoons was secured, and as the imagines emerged they were enclosed in a small glass cylinder with a sprig of rose and a few aphids. The females were not observed to mate with the males, but were frequently seen ovipositing in the plant-lice. The oviposition habits are like those of other Aphidiines as already described many times. The female bends the tip of her abdomen between her legs, and by a sudden trust darts it under her head into the abdomen of the helpless victim, completing the act in a moment of time.

By the dissection of parasitized aphids from these simple reproduction experiments, the eggs, first and second stage larvæ were easily secured, and the third stage larva was as readily obtained by opening fresh cocoons.

The eggs are undoubtedly placed one at a time in the abdomen of the host, and lie free among the organs and tissues beneath the integument. They are minute, ovoid bodies, white in color, of no special characteristic form or appearance. Like the eggs of *Platygaster* as observed by Marchal[1] they double and triple in size before hatching. This increase in size is able to take place, probably on account of the plastic nature of the chorion, which expands as the

[1] Paul Marchal. Recherches sur le biologie et le developpement des Hyménoptères parasites. Les Platygasters. Arch. Zoöl. (Paris), Vol. 4, pp. 485-640.

embryo grows by the absorption of food and fluids from the surrounding body fluids of the host.

The first stage larva proved to be of unusual interest, and of specialized structure as is so frequently the case in first stage larvæ of hymenopterous parasites. A short description of it with an outline drawing will follow later in this paper. Its extraordinary tail-like appendages are probably respiratory in function, and the comb-like arrangement of bristles on the dorsum seems to indicate that it may thereby be able to move about among the organs and tissues of the host. The assumption that the bristles may aid in its locomotion is strengthened by the fact that they all point backward, are undoubtedly of sufficient size and firmness, and occur most abundantly on the posterior part of the body where they would be most useful.

After the first molt the larva loses its extraordinary appearance and assumes the form of the ordinary hymenopterous larva. During the second stage it increases rapidly in size and begins to make inroads upon the tissues of the host, though as yet carefully avoiding the vital organs. Finally in the third and last stage the larva quite destroys all the organs of the host, including the numerous embryo aphids which the mother aphid carries in her abdomen, and after sucking up the last juices, it leaves its host as a perfectly dry shell, in order to spin underneath a characteristic white cocoon, which has been figured and described by previous authors.[1]

Specimens of the *Praon* under observation were sent to the Bureau of Entomology at Washington and identified by Mr. H. L. Viereck as *Praon simulans* Prov. The aphid acting as host was likewise determined by Mr. Theo. Pergande to be the common rose-aphid *Macrosiphum rosæ* L. Another aphid common in the local greenhouse on carnations also proved to be host of this species though less frequently attacked.

From cocoons of Praon were obtained several species of secondaries. One a species of Encyrtid was obtained under such conditions as to make it extremely probable that this species does not attack the cocoons of Praon directly, but lays its eggs in the body of the aphid, where after hatching the larva would seek out the Praon

[1] For figure of cocoon see Howard, Insect Life, Vol. 4, p. 196.

larva, enter it and finally destroy it. Only one Encyrtid was reared from a cocoon.

From a number of cocoons collected from rose-bushes recently placed out of doors at the greenhouse, there was reared a species of Xystus of the family Figitidæ, and also a species of Pteromalid of the genus Asaphes.

While making observations on Praon at the greenhouse we found another species of the Aphidiinæ rather abundant and confining its attack principally to the above-mentioned species of aphid on carnation, though occurring less commonly on the rose-aphid. This species is possibly the European *Aphidius rosæ* Hal.

Encouraged by the interesting results with Praon we started reproduction experiments with this species and soon secured the early stages. The first stage larva proved to be far less specialized than that of Praon as it lacks the dorsal combs of bristles, and the tail-like appendanges. A description with drawing is appended with that of Praon.

Specimens of the aphid host were also collected at the greenhouse and dissected. The results are exceedingly instructive and may be tabulated as follows:

20 full-grown agamic female aphids dissected.
15 of the 20 or 75% were parasitized.[1]
10 of these 15 proved to be superparasitized.[2]
5 contained two larvæ (in one case a larva and an egg).
3 contained three larvæ (in one case a Praon larva).
1 contained four larvæ.
1 contained five larvæ.

Adding up the number of larvæ or eggs found in these 15 aphids we have a total of 33, only 15 of which could have ever reached maturity, leaving 18 to perish, more than three times as many needed to destroy the five unparasitized aphids, if the eggs had been distributed more equitably.

These results are the more remarkable when we consider that oviposition took place under normal conditions in a well-lighted

[1] Two of the fifteen parasitized aphids contained larvæ so far advanced that they had already destroyed every trace of any supernumerary larvæ that might have been present previously

[2] See W. F. Fiske's paper, Superparasitism: an important factor in the natural control of insects. Jour. of Econ. Ent., vol. 3, no. 1, pp. 88–97.

and high-posted greenhouse, where host and parasite were free to follow the natural course of their instincts. They indicate how difficult or rather impossible it is for a parasite ever quite to exterminate its host, as some individuals, perhaps in more exposed positions, will be parasitized again and again, whereas others, probably less exposed, may escape destruction altogether.

An interesting problem that deserves more attention than we have had time to bestow upon it is the fate of the supernumerary larvæ. The few observations already made upon this point are, however, instructive. In most cases the supernumerary larvæ were apparently already dead, being sometimes somewhat disintegrated though bearing no marks of violence. As in all the cases where dead supernumerary larvæ were found there was still an abundance of tissues and liquids in the host for food, we cannot suppose that they were starved, nor, as there were no marks of violence found on them, can we suppose that they were killed in an active combat with a larger and older larva. We may be unwilling to believe that the more advanced and stronger larvæ secrete or excrete some fluid or material into the body of the host which eventually destroys their younger or weaker brothers and sisters, but this view seems forced upon us. This gains the more credence when we stop to consider that by some subtle influence the weak and often insignificant parasite frequently causes important pathological changes in the body tissues of its more powerful host. We have noticed this phenomenon not only in case of parasitized aphids, but also in caterpillars, notably in brown-tail caterpillars parasitized by Meteorus. The change we have in mind is the breaking up of the flaky fat-bodies into small, more or less globular bodies which are unattached and float freely in the body fluids. When in this condition the fatty tissues may be more accessible to the parasite as food.

In no case were the dead larvæ found surrounded and being destroyed by the phagocytes of the host, as we have lately observed in studies on the larvæ of Limnerium, the results of which we hope to publish shortly.

Description of the Larval Stages of Praon and Lipolexis.

1. Praon simulans Prov.

First Stage Larva: Body 14-segmented, somewhat tapering behind; last segment with a dorsal-median, cylindrical appendage nearly as long as the

preceding segment, tipped with a few short hairs, and a pair of ventral appendages much more delicate, only about half as long as the dorsal appendage. The metathoracic and first to ninth abdominal segments provided with a comb of comparatively coarse bristles along their posterior

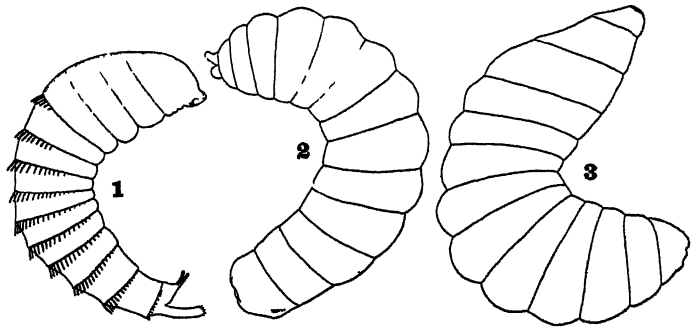

Fig. 1. *Praon simulans* Prov. 1, First Stage Larva; 2, Second Stage Larva; 3, Third Stage Larva.

margins; the comb extending nearly to lateral-ventral margins on the posterior, but becoming more and more dorsal on the anterior segments. Mouth-parts not prominent, though a pair of small but sharp and chitinized mandibles may be made out. Length .8 mm.

Second Stage Larva: Like the ordinary hymenopterous larva. Body 13-segmented (owing to the fusion of the last two abdominal segments), tapering but little at both ends. Last segment broadly rounded, somewhat indented at the tip. Head small, mouth-parts appearing as fleshy folds. Integument of body delicate and smooth.

Third Stage Larva: Resembles the preceding stage, but tapers more at the anterior end. Head small, the mouth-parts represented by folds with chitinous plates, not at all prominent. Integument rather thick and chitinous, thrown into large folds along lateral margins of body, everywhere roughened by fine granulations. Length nearly 2 mm.

2. Aphidius rosae Hal. (?).

First Stage Larva: Body 14-segmented, rather broad anteriorly and somewhat depressed, tapering gradually behind, the last segments rather deeply constricted, especially anteriorly. The head provided with a pair of projecting lobes on its posterior ventral margin on either side. Mouth-parts represented by a pair of comparatively long, curved mandibles, tipped with a yellowish spot, and prominent when protruded. Body smooth, free from hairs or bristles. Length .8 mm.

Second Stage Larva: Not readily distinguishable from the second stage larva of Praon.

Third Stage Larva: Very similar to same stage of Praon, except that it is slightly larger and head is more pointed. Length nearly 2 mm.

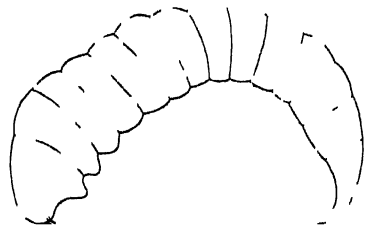

Fig. 2. *Aphidius rosæ* Hal. (?). First Stage Larva.

Before concluding we wish to take this opportunity of expressing our gratitude to Messrs. Viereck, Pergande and H. S. Smith for the determination of specimens.

TRICRANIA SANGUINIPENNIS SAY.

A female specimen of this species was taken on the under side of a piece of board in a sand pit in Framingham, Mass., April 16, 1905, and with it was a large mass of what I have considered to be the eggs. They are now very much shrunken and discolored but seem to be elongate oval in shape, measuring more than half a millimeter in length and about one third as wide.

The other inhabitants of this sand pit are *Cicindela rugifrons*, *C. generosa*, and possibly a few sand burrowing hymenoptera.

A male specimen of this beetle has recently been brought to me; this was also found in a sandy place. These two specimens are the only ones that I have seen from this locality.

C. A. Frost.

A NEW SPECIES OF APHOMOMYRMEX FROM BORNEO.[1]

By William Morton Wheeler.

Among the Camponotine ants of the Old World tropics there are two remarkable genera, *Aphomomyrmex* and *Dimorphomyrmex*, concerning which comparatively little is known. *Aphomomyrmex* was based by Emery[2] on *A. afer* from Kamerun, represented by male, female and worker specimens. He was in some doubt as to whether the worker, which had nine-jointed antennæ, was cospecific with the female and male, in both of which the antennæ were ten-jointed. He regarded the genus as allied to the neotropical *Myrmelachista* Roger, which comprises a number of species, with nine- to ten-jointed antennæ, and to *Dimorphomyrmex* Ern. André, which is represented by *D. janeti* described by Ern. André from Borneo[3] and *D. theryi* subsequently discovered by Emery in the Baltic amber.[4]

Myrmelachista differs from *Aphomomyrmex* in having a differentiated antennal club in the worker and female, better developed frontal carinæ and more laterally placed eyes, while *Dimorphomyrmex* is peculiar in possessing large, reniform eyes in the worker and presumably also in the female, which is still unknown. *D. janeti*, according to André, has dimorphic workers, a large form (soldier) measuring 6 mm., with ocelli and a large, oblong head, and a small form (worker proper), measuring only 3.5 mm., without ocelli and with a proportionately shorter head. Emery says that he has seen a worker of this species from Sumatra measuring 4.5 mm. and therefore intermediate in size between the soldier and worker of Janet. This observation seems to indicate, as Emery has asserted, that the worker is really polymorphic in *D. janeti*. Through the kindness of Prof. R. Klebs and Prof. A. Tournquist I have been able

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 25.

[2] Fourmis d'Afrique, Ann. Soc. Ent. Belg. XLIII, 1899, pp. 493–496.

[3] Voyage de M. Chaper à Borneo. Catalogue des Fourmis et Description des Espèces Nouvelles. Mèm. Soc. Zoöl. France, V, 1892, pp. 49-51.

[4] Deux Fourmis de l'ambre de la Baltique. Bull. Soc. Ent. France. 1905. No. 13, pp. 188–189.

to examine quite a number of specimens of *D. theryi* of the Baltic amber, but all of these were monomorphic.

In 1894 Emery described a female ant from Borneo as *Dimorphomyrmex andrei*[1] with eight-jointed antennæ, but he concluded that this was an *Aphomomyrmex* after he had seen *A. afer*. Each of the two genera is therefore represented by two species, as follows:

Dimorphomyrmex Ern. André.

1. *D. janeti* Ern. André, Mém. Soc. Zoöl. France, 1892, pp. 19-51, Figs. 4 and 5, soldier, worker; Emery, Ann. Soc. Ent. Belg. XLIII., 1899, p. 491, *nota*, worker; Borneo; Sumatra.
2. *D. theryi* Emery, Bull. Soc. Ent. France, 1905, p. 188, Fig. 1, ♀; Baltic amber.

Aphomomyrmex Emery.

1. *A. afer* Emery, Ann. Soc. Ent. Belg. XLIII., 1899, pp. 193-196, 1 fig. worker, ♀ ♂; Kamerun.
2. *A. andrei* Emery. Ann. Soc. Ent. Belg. XLIII., 1899, p. 891, ♀= *Dimorphomyrmex andrei* Emery, Ann. Soc. Ent. France, 1891, p. 73, ♀; Paulo-Laut, Borneo.

Among some Bornean ants collected and recently sent me by Mr. John Hewitt of the Transvaal Museum, I find two females and several workers of a third species of *Aphomomyrmex* of which I subjoin a description.

Aphomomyrmex hewitti sp. nov. (Fig. 1.)

Worker maxima. Length 3-3.5 mm.

Head flat, nearly as convex below as above, subrectangular, longer than broad, with straight subparallel sides, rounded posterior and blunt anterior corners. Eyes small, elliptical, flat, placed near the middle of the sides of the head and not on its upper surface. Ocelli present in some specimens but very small. Clypeus large, feebly convex behind, depressed in front, its anterior border rounded in the middle, not projecting, its posterior border not projecting back between the frontal carinæ to any appreciable extent. Frontal carinæ very small and short, the distance between them little more than half the distance between each of them and the corresponding lateral border of the head. Frontal area obsolete, frontal groove tenuous, but distinct. Mandibles small, with parallel internal and external borders and four sub-equal teeth; outer border with a blunt tooth near the base. Antennæ 8-jointed, short; scapes rather slender, straight, reaching only a short distance behind the eyes; first funicular joint slender, twice as long as broad, remaining joints slightly enlarged towards the tip of the antenna; joints

[1] Descriptions de deux fourmis nouvelles. Ann. Soc. Ent. France, 1894, p. 73.

2-6 as broad as long, terminal joint shorter than the three preceding joints together. Thorax thickset, depressed, as long but not as broad as the head, broader in front than behind. Promesonotal and mesoepinotal sutures distinct; mesonotum somewhat higher than the pronotum, feebly convex, forming a regular transverse ellipse. Mesoëpinotal constriction short but distinct, its bottom formed by the mesoepinotal suture only. Epinotum a little broader than long, with feebly rounded sides, its base very short and horizontal, passing through a rounded angle into the much longer, sloping and flattened declivity. Petiole somewhat lower than the epinotum and only about one-third as broad, as long as high and wide, with an erect, transverse node, which has flat anterior and posterior surfaces and a rounded

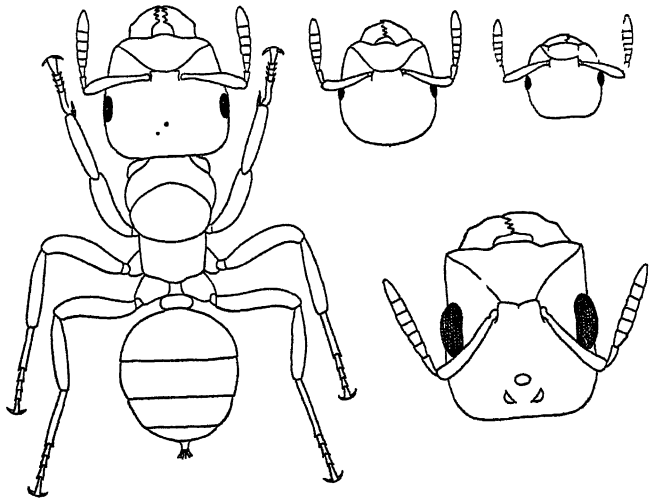


Fig. 1. Worker maxima of *Aphomomyrmex hewitti* sp. nov.; heads of worker media, worker minima and female, all drawn to the same scale.

upper surface. Gaster very broadly elliptical, smaller than the head, flattened dorsoventrally, with well-developed anal cilia. Legs long and robust; fore femora somewhat incrassated; claws and empodia large.

Body shining. Mandibles, clypeus and cheeks subopaque, punctate and finely striate, except the middle of the clypeus, which is opaque and coarsely punctate. Head sparsely, thorax and gaster more densely punctate and less glabrous.

Hairs yellowish, rather long and abundant, erect or suberect on all parts of the body and appendages, including the antennal funiculi. Pubescence yellowish, sparse and rather long, distinct on the thorax and gaster only in certain lights.

Dark brown or black; mandibles, cheeks and clypeus deep red; articulations of legs and thorax, antennal funiculi and tarsi more yellowish.

Worker media. Length 2.8 mm.

Closely resembling the worker maxima, but the head is somewhat smaller and distinctly narrowed anteriorly, and the clypeus and cheeks are less deeply punctate and striate and therefore more shining. Ocelli absent. Antennal scapes reaching about half way between the eyes and the posterior corners of the head. Tooth on the external border of the mandibles obsolescent.

Worker minima. Length 2 mm.

Resembling the worker media, but the head is smaller, only a little longer than broad, as broad in front as behind, with feebly rounded sides, straight posterior border and rounded posterior corners. Ocelli absent. Clypeus convex and shining, its sides and the cheeks scarcely striate. Mandibles small, without a tooth on their external borders. Joints 2-6 of the antennal funiculi a little broader than long; scapes reaching half way between the eyes and the posterior corners of the head. Thorax not constricted in the mesoepinotal region above. Gaster as large as the head. Mandibles, clypeus, antennæ and petiole yellowish like the articulations of the legs and thorax.

Female. Length 6-7 mm.

Body long and narrow. Head like that of the worker maxima but larger and with much larger eyes and well-developed ocelli. Clypeus very flat. Antennæ 8-jointed; scapes reaching about one-third the distance from the eyes to the posterior corners of the head. Second funicular joint as long as the first, which is fully twice as long as broad; joints 3-6 subequal, fully as long as broad and not increasing in width distally, terminal joint shorter than the two preceding joints together. Thorax as broad as the head, but twice as long, from above regularly elongate-elliptical, dorsally depressed, evenly and feebly rounded. Sides of neck much swollen and projecting anteriorly. Mesonotum and scutellum each somewhat broader than long; epinotum very feebly rounded above, uniformly sloping, without distinct base and declivity. Petiole nearly as high as the epinotum, as long as high and broad, its node thick and cuboidal in profile, seen from above transversely elliptical. Gaster elongate elliptical, nearly as large as the thorax. Legs long and stout, with large claws and empodia. Wings moderately long (6 mm.); venation as in *Plagiolepis*.

Sculpture and pilosity like those of the worker maxima.

Black; mandibles (except the teeth), clypeus, antennæ, tarsi, metanotum, anterior border of scutellum, articulations of the thorax, wings and legs, red; wings uniformly infuscated, with brown veins and blackish stigma.

Described from two females, six maxima workers, one media and one minima, taken by Mr. John Hewitt at Bidi, Borneo, during August, 1907, "in the swollen internode of a shrub." This remark,

together with the strong development of the claws and empodia and the peculiar head of the maxima and female, so like the conditions in certain wood-inhabiting *Camponoti* and *Colobopsis,* shows that *A. hewitti* is a timid tree-ant, which habitually nests in small colonies in vegetable cavities.

Judging from Emery's decription, *A. andrei* must be very closely related to *hewitti,* but only the females of the two forms can be compared as the workers of Emery's species are unknown. The female of *andrei* is of a brown color and measures only 5-6 mm., its antennal scapes scarcely surpass the posterior borders of the eyes, the median joints of the antennal funiculi are broader than long and the petiole is longer than high and broader than long. In other respects the two species are very similar.

On comparing *A. hewitti* and *andrei* with Emery's description of *A. afer* one is tempted to conclude that the two Bornean species may be generically, or at least subgenerically distinct, since the African species differs from them in having three-toothed mandibles, nine- to ten-jointed antennæ, the eyes less laterally situated and the frontal carinæ longer and further apart. I have thought it best, however, not to place the Bornean and African species in different genera or subgenera till more material of the latter is available and till the males of the Bornean species are brought to light.

LEPIDOPTERA ON MILKWEED.

The following species of Lepidoptera were collected at Wales, Maine, July 11, 1904, with the aid of a common lantern, from the drooping flower heads of the milkweed (*Asclepius incarnata* L.): *Autographa rectangula,* three specimens; one specimen each of *Acronycta, innotata, Hadena vultuosa,* H. *remissa, Noctua lubricans, N. haruspica, Mamestra atlantica, M. subjuncta, Leucania insueta,* and L. *commoides;* several specimens each of *Euxoa redimicula, Acronycta interrupta, Heterophleps triguttaria,* and *Synelys enucleata.*

C. A. Frost.

THE FORMATION OF THE OOTHECA OF A CHINESE MANTIS, *HIERODULA SAUSSURII*.

By J. C. Kershaw.

This large and handsome Mantis, bright green in its wet season or summer dress, various shades of brown in dry season, appears almost invariably to construct its very complex ootheca during the night, or very early morning. They pair like locusts, the male clasping the female round the thorax with his forelegs. They seem to copulate two or three times for about three hours at a time on separate occasions during two or three days. After the last coupling, unless the male is very smart in disengaging himself, he is often caught and killed by the female, though he is not much smaller, being some two and one-half inches from the face to the tip of the abdomen. Once fertilized, the female makes four or more oothecæ at intervals of about twenty days, the first being made about nine days after the last coupling. It would seem, therefore, that the female is fertilized once for all. The oothecæ are made chiefly during September to January inclusive, i. e., mostly during the dry season or winter. They are constructed on tree-trunks, twigs, walls, boulders and many other objects. The female is fond, however, of getting a more or less vertical support against which to make the preliminary plates, besides a horizontal foundation for the floor of the ootheca. The oothecæ are fixed in all positions, both vertical and horizontal, but the female seems specially fond of working with her back downwards. Before commencing an egg-case, the Mantis is restless and keeps turning the abdomen (which is much swollen and heavy) laterally and letting it hang for some time first one side and then the other. She also walks slowly up and down, feeling various surfaces with the tip of the abdomen. Whilst making the ootheca the female grasps the twig or bark with her forelegs. The wings are closed and the tips held high above the back of the abdomen, out of the way. The cerci are incessantly used to gauge the outer dimensions of the case. One of ordinary size, say about an inch in length and containing perhaps two dozen egg chambers, takes two to three hours to com-

plete. At first the colleterial matter is whitish, but is soon variegated with bluish and greenish; it afterwards turns brown, but for some hours it remains in a more or less soft condition. In a few days it becomes extremely hard and tough.

The oothecæ are parasitized badly by a species of *Dermestes*, whose larvæ destroy the whole interior. Besides this beetle, a small Hymenopteron (*Podagrion* sp.) and the larva of a moth are parasitic on Mantis eggs, and emerge by small round holes through various parts of the ootheca; but these parasites do not destroy the plates of the egg chambers, as the beetle larva does. At least seventy to eighty per cent. of the oothecæ are parasitized, and this is judging from several hundred egg-cases collected for some years over a very wide area.

The female has two sets of large colleterial glands, one set each side of the abdomen. They consist of long tubes, narrowing gradually to a blind end, and at the base uniting into one large, short duct; the two ducts of each set of tubes join in one large and very short duct opening into the dorsal side of the vagina. Close behind this duct are two small branching glands, also joining in a short, common duct. There is a large, globulate spermatheca.

The ootheca consists of two parallel rows of egg chambers (a row each side of the longitudinal center of the case, with about a dozen chambers in each row), the chambers of one side being half the depth of a chamber behind (or in front of) the chambers of the other side. Each chamber is formed by two plates, each plate forming the back of one chamber and the front of another. The plates overlap, a little beyond the vertical center, first one side and then the other, and are cemented together along this joint. At the top each plate expands laterally to the full width of the flaps, and a little higher still the cementing ceases and the flaps become free from each other. The flaps may be considered thin and flexible continuations of the plates, and are bent forwards at a rather sharp angle to form a protecting roof over the exits of the chambers. The sides or flanges of the chambers are formed by strips cemented around the outer edges of the plates. Outside the egg chambers is another covering or casing, formed by broad strips twisted at the top so as to attach to the base of the flaps; these strips overlap (or are received into) each other, and at the bottom are also twisted

and broadened into feet, which also overlap one another and are cemented to whatever foundation the ootheca is being constructed upon. The feet of the egg plates (which also slightly overlap each other) rest upon and are cemented to the feet of the coverstrips — thus an air-space is left between the mass of egg chambers and the outer casing formed by the coverstrips. This air-space is, however, often roughly divided into cells by the ragged edges of the egg plates projecting between the flanges of the chambers, as indicated by dotted lines at 22, Fig. 5, Pl. 1. The coverstrips at the two ends of the ootheca are brought together and overlapped very much like the planking at the bows and stern of a boat. There are usually two or three roughly-formed smaller chambers, without eggs, at both ends of the egg-case. Those at the back end (increasing in size) form the foundation or support for the egg chambers proper; those at the front end (decreasing in size) bring the chambers gradually small enough to be closed by a single central plate (Cp, Fig. 2, Pl. 1).

In brief, the ootheca consists of an outer casing formed of overlapping coverstrips, within which are two parallel rows of egg chambers, so cemented together as to form a hard, tough mass.

The process of construction is somewhat as follows: A small plate (B, Fig. 2, Pl. 1) forming the back end of the ootheca having been cemented to the bark or other object, an outer coverstrip (CVS, Fig. 2, Pl. 1) is attached each side. Two or three more small but increasing plates are added, with their respective coverstrips, so that the feet of the latter now project forward some distance along the bark, and form a foundation for the feet of the egg plates. An egg plate (EP, Fig. 2, Pl. 1) is now formed against the last small plate (E, Fig. 2, Pl. 1), a flap (FL, Figs. 1 and 3, Pl. 1) is added, an outer coverstrip (CVS, Fig. 2, Pl. 1) attached, a closing membrane (CM, Fig. 1, Pl. 1) stuck on, and finally the eggs laid in the numbered order. After the eggs are laid and before the next egg plate covers them they are, nevertheless, covered with a thin film of colleterial matter, extending to the top of the closing membrane. The superabundant colleterial matter also becomes (by mutual pressure of eggs and egg plates) squeezed into the interstices between the eggs, forming little ridges or partitions between the eggs, rather deep near the outer

edges or flanges of the egg plates, but altogether working out and disappearing in the central part of the egg plate, thus leaving a passageway for the nymphs from the lower eggs. The hollows where the eggs lie and the ridges between them are shown on the left-hand egg plate in Fig. 7, Pl. 2.

The insect next makes the egg plate and its concomitant parts for the egg chamber of the opposite row, and lays the eggs thereon. It next forms another egg plate over the eggs first laid, and thereafter adds a chamber alternately to each row until the whole batch of eggs is laid; then a few small, rough chambers decreasing in size and without eggs are added, and finally the ootheca is closed by one small central plate.

Turning to Pl. 2 and following the construction of an egg chamber in detail: An egg plate (Ep, Fig. 1) is first made; a flap (FL) is cemented on; a flange (FG, Fig. 2) is next cemented around the outer edge of the egg plate; then a coverstrip (CVS) is attached; and a closing membrane (CM, Fig. 3) renders the plate ready for the eggs. This closing membrane is a membraneous flap of colleterial matter, thin and flexible, which is cemented all around its edge to the egg plate, except across the top; it bulges outwards from bottom to top, where it rests against the egg plate next added, and thus closes the exit from the chamber; but it is easily thrust back against the back plate of the chamber when the nymphs are squeezing their way out. The mode of junction of the egg plates is shown specially in Fig. 7, Pl. 2, and Fig. 5, Pl. 1, where the joints are purposely left not quite touching, as in some of the other figures, for the sake of clearness, but of course they are really closely cemented together. At Fig. 4, Pl. 2, is shown a side view of an egg plate, without the coverstrip; at Fig. 5, Pl. 2, three coverstrips cemented together. At Fig. 6, Pl. 2, a vertical section through an egg chamber on the line c—d, Fig. 7. At Fig. 7 three egg chambers are shown in plan, the single chamber projected from Fig. 6. In Fig. 6, fl^2 is part of the flap of one of the chambers in the opposite row.

The shape of the flaps in transverse section is shown at UV, WX, YZ, Fig. 4, Pl. 1, representing sections across the flaps at about the heights of the corresponding lines in Fig. 3, Pl. 1. It will be seen that at YZ the flaps are joined or cemented together

both at the ends and middles; at WX they are joined only at the ends; at UV they are altogether free. As the plates of the egg chambers in one row have flaps which are of equal breadth on either side of the longitudinal center of the ootheca, and as this is also the case with the chambers in the other row (which are half a chamber's depth behind or in advance) it follows that the flaps of the chambers on either side interlace. The lower edges of the two flaps forming an egg chamber are rigidly held on the outside of that row by two corresponding coverstrips; but the edge of the flap which comes across from the chamber of the opposite row and lies between the two former flaps is slightly within the full width and is left uncemented till a little lower down, and can thus be pushed slightly back by the emerging nymphs. Thus on each side of the row of flaps the lower edge of each flap is held rigidly or is semi-free alternately.

It may be added that some oothecæ are very small, having perhaps but six egg chambers; others have more than thirty, but the average length of an egg-case is about an inch, with about twenty-four chambers.

EXPLANATION OF PLATE 8.

Figure 1.

A, external side view, part of the exterior casing formed by the coverstrips broken away, exposing two egg chambers in the near row.

B, vertical section through longitudinal center.

C, vertical section (on line m—n, Fig. 3) through two egg chambers in the far row.

D, external side view of back end.

ec, egg chambers in far row.

ec,[1] egg chambers in near row.

em, closing membrane.

Figure 2.

A[1], external top view.

cp, cover-plate.

B[1], external top view, the flaps cut away as at UV.

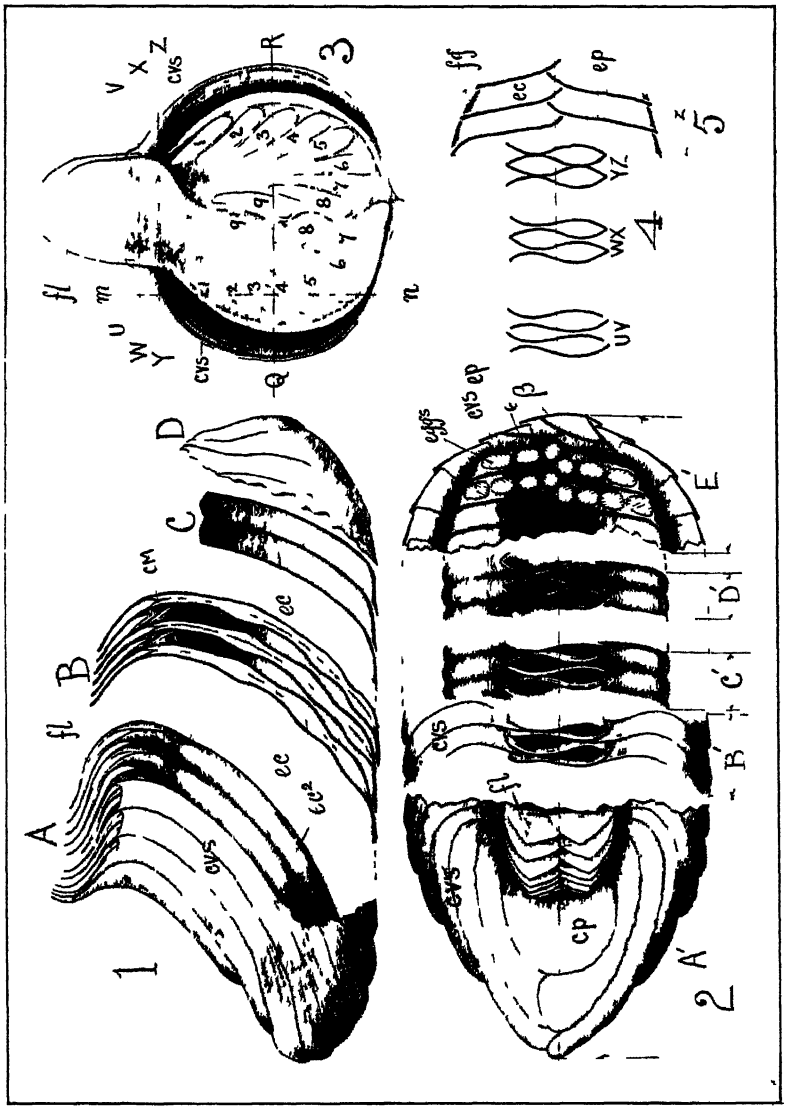
C[1], top view, outer casing removed, flaps cut away as at WX.

D[1], top view, outer casing removed, flaps cut away as at YZ.

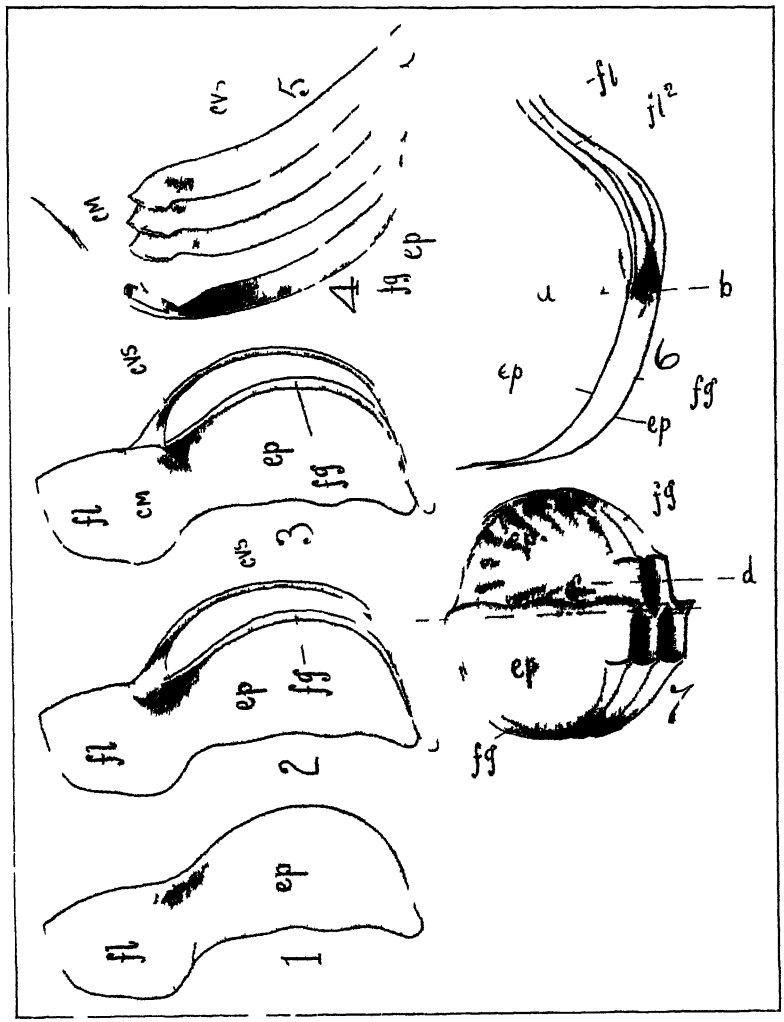
E[1], horizontal sections (on line Q—R, Fig. 3) through egg chambers.

e, last small plate forming rough chamber without eggs.

B, cover-plate.



KERSHAW—OOTHECA OF HIERODULA SAUSSURII.



KERSHAW—OOTHECA OF HIERODULA SAUSSURII

FIGURE 3.

Transverse view about the middle of the ootheca. The covering plate of the right hand chamber removed. The flange, coverstrip and closing membrane not yet attached to the left-hand plate. The tips of the flaps are shown more or less straight up, instead of bent sharply forwards, as they are naturally.

1, 2, 3, etc., the eggs laid in the order of their numbers.

FIGURE 4.

UV, section of flaps through line UV, Fig. 3.
WX, section of flaps through line WX, Fig. 3.
YZ, section of flaps through line YZ, Fig. 3.

FIGURE 5.

Horizontal section through egg chambers of the back end of the ootheca, about the line Q R, Fig. 3. *zz*, ragged edges of egg plates, which sometimes project between the flanges.

In all the figures of this plate: fg =flange; fl=flap; cvs=coverstrip; ep= egg plate; ec egg chamber.

EXPLANATION OF PLATE 9.

Fig. 1, egg plate and flap cemented together.
Fig. 2, same, flange and coverstrip added.
Fig. 3, same, closing membrane added.
Fig. 4, same side view, but coverstrip not shown.
Fig. 5, three coverstrips cemented together.

FIGURE 6.

Vertical section through left-hand chamber, on line c—d, Fig. 7.
Fl', flap coming across from a right-hand chamber.

FIGURE 7.

Top view of three egg chambers, the upper part cut away about the line a b, Fig. 6.

In all the figures of this plate: ep =egg plate; fl=flap; fg=flange; cvs coverstrip; cm closing membrane.

SOME NEOTROPICAL BEES.

By T. D. A. Cockerell.

Hemisia lanipes (Fabr.).

Antigua, West Indies (*C. A. Barber*) Brit. Museum.

Hemisia semilabrosa sp. nov.

♀. Length 13½ mm.; almost exactly like *H. labrosa* (Friese), but the labrum, though longer than in *H. lanipes*, is still evidently broader than long; the clypeus is smooth and very sparsely punctured, with the median third concave; the abdomen is entirely clear red; the hair on the inner side of the hind basitarsus is very dark chocolate, but that on the outer side of the hind legs is pale reddish. The concave clypeus suggests *H. montezuma* (Cress.). Labrum notched at apex, pale yellow with two oval pale brown marks; mandibles pale yellow basally, a minute elevation on inner side toward the base, and the apical half with three teeth, the large apical one, a small one projecting from its side, and a large sharp tooth on inner side not far beyond the middle; under side of head with long white hair; eyes straw-yellow, rather narrowly fuscous in front; scape short, dark; flagellum dark ferruginous beneath except at base; front with pale yellowish-grey hair more or less tipped with fuscous; vertex with black hair; thorax above with short light greyish-brown hair tipped with fuscous; at sides the hair is pale ochraceous, not dark-tipped; tegulæ pale testaceous; wings dilute smoky, nervures black, venation practically as in *lanipes;* legs dark, with pale reddish hair, the hind tibiæ, and middle and hind tarsi, becoming ferruginous; anterior and middle basitarsi each with a longitudinal, curved, sharp keel on anterior margin toward the inner side; anterior and middle knees with a small pale yellow spot; the scanty hair of abdomen rufofuscous, clear red at apex. General appearance like *H. lanipes,* but larger, with the two large yellow marks on the clypeus triangular.

Hab.—Ecuador (*Rosenberg*). British Museum, 99–104. In Friese's table of the subgenus *Rhodocentris* this runs nearest to *H. tarsata* (Smith), which is only known in the male. *H. tarsata* comes from Santarem, and is only 9½ mm. long, and otherwise seems distinct from *H. semilabrosa.*

Agapostemon swainsonae sp. nov.

♂. Length about 8 mm.; head and thorax brilliant green, abdomen and legs dull ferruginous; front and mesothorax smooth and shining, with a very strong golden lustre, the sculpture consisting of delicate weak striæ

and very minute and sparse punctures; clypeus prominent, with an obtuse but strong median ridge; at each side of the clypeus, toward the apex, is a small shining black tubercle, and the apical margin is broadly pale yellow, the labrum, and mandibles except apex, being of the same color; hair of face and vertex strongly tawny, of cheeks dull white; scape yellow in front; flagellum dark ferruginous above, light ferruginous beneath, the apical half crenulate; scutellum smooth and shining, with very minute punctures; pleura roughened anteriorly, strongly striate posteriorly; metathorax without any defined enclosure or sharp margin round the apical truncation, the whole surface strongly striate, the striæ oblique, those on the truncation approximately at right angles to those on the part above; sides of metathorax with pale yellowish coarsely plumose hair; tegulæ pale rufotestaceous; wings rather dusky, stigma and nervures dark brown, first r. n. joining second s. m. far beyond the middle; legs ferruginous, the hind femora greatly swollen, dusky above, with a broadly triangular tooth beneath toward the apex; hind tibiæ thick, the inner edge sharp; hind basitarsi with a prominent obtuse tubercle beneath; abdomen dark ferruginous with a slight purplish (not metallic) tint, the hind margins of the segments broadly paler.

Hab.—Jamaica (*Mrs. E. M. Swainson*). Brit. Museum. Nearest to the Cuban *A. femoralis* Guérin, but easily known by the smooth, shining mesothorax and scutellum.

Augochlora regina Smith.

♀. Jamaica; "P. G. R., St. Thomas, June." (*Mrs. E. M. Swainson*). Brit. Museum.

Coelioxys foxii Viereck.

♂. Kingston, Jamaica, Nov., 1893. Brit. Museum.

Melissa friesei Ducke.

♂. Brazil (*W. H. Bates*); F. Smith collection. Brit. Museum. Although long ago discovered by Bates, this beautiful species was not described until 1902. The specimen before me has the abdomen brilliant blue; Ducke's description says "nigrocæruleus." The bifid spur of the middle tibia has the anterior branch quadridentate, a fact not indicated by Ducke, and the specimen is a little smaller than Ducke's type. It is just possible that actual comparison would indicate that our insect is separable, but except for the points mentioned, the structural and color characters are all in accord with *M. friesei*. *M. maculata* Friese must be closely allied.

M. decorata Smith was described from "Brazil." The original specimens were taken by Bates in S. Paulo.

Mesocheira bicolor (Fabr.).

A female in the British Museum, labelled "Guiana," is only 10 mm. long.

Isepeolus octopunctatus (Jörgensen).

Jörgensen described this species (under Epeolus) in 1906 from a single female. Two of the same sex are in the British Museum, from Patagonia (V. del Lago Blanco, *Chubut*). They agree with the original description, except that they show two more small white spots on the abdomen, on the hind margin of the fourth segment. In one of the specimens these spots are barely visible. Jörgensen remarks that his species is allied to *E. luctuosus* Spinola. From the particulars given by Jörgensen and F. Smith, I suspect that *Isepeolus albopictus* Ckll. may not be separable from *I. luctuosus* (Spin.), the latter being no doubt an *Isepeolus*. It is to be noted, however, that *I. luctuosus* was described from Chile, and was considerably smaller than *I. albopictus;* it is not unlikely that there are two species, one Chilian and the other in the Argentine, the latter being really *albopictus,* though recorded by Jörgensen as *luctuosus*. The genus *Calospiloma* Brethes, based on *Epeolus viperinus* Holmg., can hardly be separated from *Isepeolus,* unless the tridentate mandibles may suffice for the purpose. Brethes refers *I. luctuosus* to *Calospiloma*.

THE CHALCIDOID PARASITES OF THE COMMON HOUSE OR TYPHOID FLY (*MUSCA DOMESTICA* LINN.) AND ITS ALLIES.[1]

III. Description of a New North American Genus and Species of the Family Pteromalidae from Illinois, Parasitic on *Musca domestica* Linn., with Biological Notes.

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The type species of this new and important genus of the pteromaline tribe Eutelini, was in point of numbers, third among the chalcidoid parasites reared by us during the investigations of the common house fly, during the latter part of the season of 1908, it being less numerous than species of Spalangia and the parasite *Nasonia brevicornis* Ashm. Unlike the latter, however, it was not reared independently or from a number of hosts, but nearly always occurred in connection with some one of the species of *Spalangia* and we were inclined to believe, though the evidence was lacking, that it usually attacked that genus, and hence is a secondary parasite of the typhoid fly, though its rôle may also be that of a primary parasite. A fact which contributed to our belief of its secondary rôle is the general likeness which it exhibits to Spalangia, a not uncommon thing between host and parasite or host and inquiline, though by no means the rule. But we have no evidence whatever to show that this is the case and are forced to the conclusion that the type species of the genus is a primary parasite in every sense.

In this third paper of this series, the genus is described and considered in detail and such biological facts as we were able to observe concerning it are also given. This genus, Spalangia and *Pachycrepoideus dubius* Ashm., already considered, are the principal primary parasites of the house fly, the species of Spalangia being the most numerous and common of the three genera. They will be considered in a paper to follow.

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[1] Continued from Vol. XVII., p. 117.

Family Pteromalidae.

Subfamily Pteromalinae.

Tribe Eutelini

Muscidifurax gen. nov.

Type: *M. raptor* sp. nov.

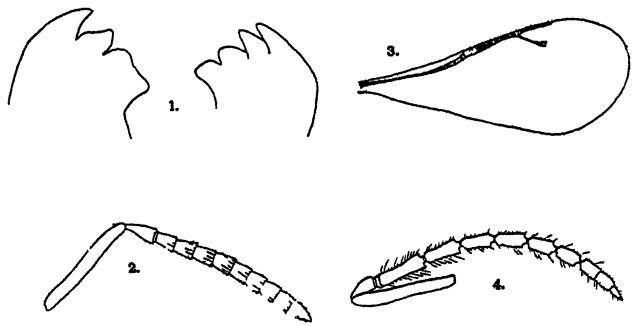
Female. Normal in stature and aspect for the tribe. The general aspect of *Tritneptis* Girault, 1908, and of *Cœlopisthia suborbicularis* Prov. (Ashm.); moderate in size, the head rounded and prominent; submetallic, black.

Head (cephalic aspect) subcircular, moderate in size, the line of the vertex, however, somewhat flattened, slightly bi-lobed, the facial (mesal) impression containing the scapes distinct, moderately deep, but gentle, moderately defined and narrow, its lateral margins obtuse, the scrobes subobsolete dorsad, distinct near the bulbs, the latter separated; face broad, the clypeus sub-hemispherical, its surface not impressed below the face, but with close, fine, longitudinal, converging striæ, its sutures obsolete, its apical (ventral) margin truncate but laterad, on each side of the comparatively broad entire mesal portion of the margin near the lateral termination of the sclerite is a small subacute notch or incision; (lateral aspect) head distinctly bulged or convex below (ventrad) its middle, forming in the cephalic aspect, a rounded, convex facial prominence just ventrad of the insertion of the antennæ; head widest just ventrad of the ventral ends of the eyes and then ventrad of the insertion of the antennæ obliquely truncate (cephalo-caudad), the line of the face sloping gently from the vertex to the antennal insertions and then abruptly, obtusely changing angle and nearly truncately cut off; obovate; eyes elliptical-ovate, about a fourth longer than the genæ, practically naked, but bearing sparse, very minute, erect hairs; head with no acute margins; genal sulcus obsolete. (Dorsal aspect) head somewhat wider than the greatest width of the thorax, about three times wider than long at the vertex, the latter slightly narrowed at the meson, but rounded and slightly convex at its apex at the ocelli, the occipital margin concave, narrowly rounded; the cephalic margin of the vertex obscure, subacute; the cephalic ocelli circular, larger than the ovate lateral ones, all in a flat or obtuse triangle in the center of the vertex, distant from the eyes, the lateral ocelli about twice the distance from the eye margins on each side as they are from the cephalic ocellus, and a little less than that distance from each other than each is from the cephalic ocellus, the group near the obscure cephalic margin of the vertex; visible margin of the eyes convex, entire; eyes widely separated. Antennæ inserted about two-thirds of the way down to the clypeus, below the middle of the face and about on an imaginary line drawn between the ventral ends of the eyes, or slightly ventrad of it, the scapes long and slender,

[1] *Muscidae* and *furax*, inclined to steal.

diverging and dorsad extending to the apex of the vertex, the flagellum long and cylindrical, slightly thickening distad; antennæ 13-jointed—scape, pedicel, 1 ring-joint, 7-jointed funicle and 3-jointed club; pedicel longer than the first funicle joint, the first and second joints of the funicle longest, the first joint the shorter of the two (Fig. 2). Mandibles 3- (left) and 4-dentate (right) (Fig. 1).

Pronotum distinct, narrow, transverse mesially, widening laterad, the lateral wings being cuneate, mesially not longer than a fourth of the length of the mesoscutum; thorax flatly convex; parapsidal furrows distinct, incomplete, inconspicuous, extending about one-half the length of the scutum, from the cephalic margin; axillæ widely separated; mesoscutum elliptical in outline, both the cephalic and caudal margin being broadly convex, the caudal margin nearly straight between the axillæ and im-



Muscidifurax raptor sp. nov.

Fig. 1. Mandibles. Fig. 2. Antenna of female. Fig. 3. Fore wing of female (ciliation omitted). Fig. 4. Antenna of male. All enlarged; pubescence indicated only, not exact. Original.

pressed; scutellum with no transverse grooved line cephalad of the apex, but in its disk a few obscure, large punctures similar to those on the heads of many encyrtine genera, its apex broadly convex; mesopostscutellum narrow, following the outlines of the scutellum, its cephalic and caudal margins ridged or carinate; metathoracic spiracle moderately large, elliptical-oval, oblique in position and nearly its own length from either the mesopostscutellum or the lateral carina; median and lateral carinæ of the metathorax complete; median carina of the metathorax divided before base, each division proceeding latero-caudad to meet the lateral carinæ; the latter broken at caudal third; spiracular sulcus short, obscure. The whole of the head and thorax densely reticulated, amounting to punctation, the metathorax more coarse, punctate and rugose; abdomen finely, delicately reticulated, polished, the coxæ finely reticulated, nearly smooth.

Abdomen sessile, (lateral aspect) conic-ovate, concave dorsad longitudinally, convex or ridged along the meson ventrad and pointed caudad, with the tip of the ovipositor exposed, not compressed, subdepressed, as long as the head and thorax combined; (dorsal aspect) abdomen ovate, ending in a sharp point, widest at about the apex of the third segment, the second segment longest, occupying a fourth of the surface, segment 3 next longest, excepting 7 and 8, a third shorter, segments 4 and 5 subequal, slightly shorter than segment 3; the sutures between segments 2 and 3 obscure; segment 6 subequal to 3 but distinctly narrower, segment 7 triangular with the apex of the triangle caudad, at the meson three-fourths the length of segment 2; segment 8 pointed conical, as long as segment 6, the point of the ovipositor protruding from it slightly; segments 7 and 8 pubescent. Abdomen somewhat variable in shape, sometimes slightly triangularly produced ventrad at base.

Legs normal, the anterior and posterior femora with their caudal margins convexed in the middle, but not conspicuously or abnormally so, the tibial spurs all single, the cephalic ones largest, curved, notched at the apex; caudal tibial spurs not half as long as the slender proximal tarsal joint, which is longest, the fourth caudal tarsal joint as usual, shortest, the third nearly as short as the fourth, the second about half as long as the first and longer than the fifth. Caudal coxæ largest, their lateral aspect flat, the intermediate coxæ by far smallest. The cephalic coxæ subconical.

Fore wings normal, widest at a point opposite the stigmal knob, usually ciliate in the disk, the apex rounded; submarginal vein slender, its whole length gently concavely curved, slightly enlarging as it nears the marginal vein, about a third longer than the latter; marginal vein broadened, clavate, its base twice the width of the postmarginal vein, gradually narrowing distad, dark, nearly twice the length of the postmarginal and stigmal veins; the latter two veins, slender, short, subequal in length, the postmarginal vein slightly longer, the angle between them about 45°; the stigmal vein straight, bearing a small ovate knob with an uncus proceeding from its cephalo-distal margin near apex. Marginal cilia absent, excepting along the venation and distad along the caudal margin where they disappear as the apex of the wing is neared; short. (Fig. 3). Posterior wings widest before their middle; the cephalic margin of the wing is nearly straight, obliquing distad; the caudal margin broadly convex, broadly emarginate towards base, sloping distad but the apex obtuse; discal cilia dense, but delicate and minute; marginal cilia moderate in length on the caudal margin. Venation usual; about 22 hooklets. Maxillary palpi 4-jointed, the last joint much the longest, cylindrical oval. Labial palpi 3-jointed.

Male—The same. Eyes smaller, about the length of the genæ, ovate; antennæ more slender, filiform, more noticeably hairy, pilose, more loosely jointed, the distal funicle joints subpedunculate; 14-jointed, with two ring-joints and a 4-jointed club; the funicle but 6-jointed, the first funicle joint very long, cylindrical, narrowed in the middle, the joints shortening distad,

the pedicel much shorter than the first funicle joint; apical joint spur-like (Fig. 4). Abdomen depressed, ovate, sessile, not as long as the thorax, the genitalia exserted in death; mandibles and other characters as in the female.

A genus closely allied to *Eutelus* Walker and *Platymesopus* Westwood, from both of which it is separated by the single ring-joint of the female antennæ, as well as more general characters.

Host Relations of the Genus.

The type and sole species of this genus, as our records given beyond will show, is an important primary parasite of the common house fly, of solitary habit and external, attacking the host in the puparium stage but not penetrating the body of the inclosed pupa, its larva obtaining nourishment through the body-wall of its host by means of absorption. Its host relations are therefore very similar to those of Spalangia — those species attacking Musca — in that it is mostly confined to a single host and is external and solitary in habit. But seemingly unlike the species of Spalangia, which we consider in another paper, this parasite also occasionally attacks other host genera, we having reared it rarely from the puparia of both the screw-worm fly, *Chrysomyia macellaria* (Fabr.) and also *Phormia regina* (Meig.); from the latter in the laboratory as well as in nature. Rarely, it was also reared from the larva of both of these flies.

Distribution of the Genus.

We have found this genus in what is practically a single locality in Illinois; in the two adjoining towns of Champaign and Urbana. In that locality it is common. Other portions of the state have not, of course, been explored in reference to it and we have no knowledge concerning its distribution in the United States.

The Type Species of the Genus.

Muscidifurax raptor sp. nov.

Female. Length variable; maximum length, 2.60 mm.; minimum length, 1.80 mm.; average length, 2.24 mm.; range, 0.80 mm.; mode, 2.30 mm.

General color black, with slight ænescence, subcorvinus; flagellum deep black, appearing slightly greyish from the pubescence; the abdomen with some brownish, at base ventrad on segment 3, a yellowish-brown spot on each side of the meson, often contiguous forming a transverse yellowish-

brown band, and with traces of yellowish-brown dorsad at base of the second abdominal segment; the legs, excepting the concolorous black coxæ, and the scape fuscous, the femora dorsad and laterad variable, usually with blackish, especially in the caudal and cephalic femora; scape darker dorsad, pedicel and ring-joints with some yellowish; exposed portions of the mandibles black or dark fuscous; palpi dusky; tegulæ black; tarsi slightly paler, their distal joint black; wings subhyaline, the marginal vein conspicuous, black, especially proximad, the remaining venation dusky with some yellowish. Eyes dark garnet, with several discal black spots; ocelli pinkish, inconspicuous. Ventum concolorous, except as noted in the abdomen.

Pubescence of body moderately close, inconspicuous. Abdomen polished.

Flagellum moderately densely pubescent, the hairs short and closely applied; scape cylindrical, narrowing somewhat distad, equal in length, nearly, to the pedicel, ring-joint and 3 proximal funicle joints combined; pedicel long-obconic, its proximal end slightly curved, nearly thrice wider at its apex than at its base, not quite a third of the length of the scape and at least a fourth longer than the first funicle joint and its apex wider than that joint; ring-joint transverse, not as wide as the pedicel and about a fifth the length of the first funicle joint; first and second funicle joints subequal in length, both widening somewhat distad, the second somewhat wider than the first, each nearly a third longer than any of the next five funicle joints which are subequal in length, each, however, very slightly shorter than the one immediately preceding; the proximal club joint subequal in length and width to the seventh or distal funicle joint, the intermediate joint small, the apical joint small, obtusely conical, half the size of the preceding. Funicle joints 2–7 subquadrate. Club as a whole ovate, not much, if any, wider than the funicle, not equal to the united lengths of the three distal funicle joints (joints 5, 6 and 7 of funicle).

(From 194 specimens.)

Male. Length variable; 1.3–2.2 mm.; average, 1.82 mm.

The same as the female, differing in the usual secondary sexual characters pointed out in the generic description, and in color as follows: The base of the abdomen in the dorsal aspect has a large conspicuous, rounded, honey-yellow spot, distinct to the naked eye, which is but slightly indicated in the female by the presence of some yellowish-brown in that region; in the same region ventrad, the area is larger than that in the female and rounded. The antennæ have an additional ring-joint, one joint less in the funicle and a very minute, additional fourth club joint, which are the unusual secondary structural features.

Flagellum filiform, pilose. Scape slender, a fourth longer than the pedicel, ring-joints and first funicle joint united; pedicel obconic, not as long as in the female, not by far a half the length of the proximal funicle joint, subequal in length to the distal (6th) funicle joint; ring-joints transverse, the second nearly twice the size of the first and darker in color; funicle joints all longer than wide, abruptly shortening distad; first funicle

joint by far the longest, cylindrical, narrowed or constricted obtusely at the middle, over half the length of the scape, subequal to the club in length, somewhat shorter, with an indication of a petiole or peduncle at its apex and a third longer than the second funicle joint; the latter slightly constricted at proximal third, with a more distinct petiole, the third and fourth funicle joints subequal, each a fourth shorter than the second funicle joint; funicle joints 5 and 6 subequal, each a fourth shorter than either the third or fourth funicle joints, and each about half the length of the proximal funicle joint. Petiole or peduncle of joints 3, 4, 5, and 6 of the funicle distinct but not long; funicle joints 5 and 6 acute at their disto-lateral angles, the others less distinctly so; club moderately long, tapering to a point, distinctly shorter than the scape, its proximal joint somewhat shorter than the sixth funicle joint, but nearly as wide, its second joint slightly longer and as wide, its third joint conical, with a narrow truncate apex, not quite as long as the proximal joint, and the fourth distal joint minute, nipple-like, resembling a small conical spur and terminating in a seta.

(From 80 specimens.)

Types: Accession No. *40,250,* Illinois State Laboratory of Natural History, Urbana, Illinois, 32 ♂'s, 81 ♀'s, tagmounted.

Cotypes—Cotype No. *12,240,* United States National Museum, Washington, D. C., 2 ♂'s, 2 ♀'s, tagmounted.

Viewed with a hand-lens, the female is uniformly glossy black with a conic-ovate, smoother abdomen which projects to the tip of the wings, marked ventrad near base with brownish-yellow, the wings hyaline with brownish-black marginal, postmarginal and stigmal veins, the latter distinctly tapering from the thicker base to apex; the legs, excepting black shining coxæ, brownish-yellow marked indistinctly with darker, the lateral aspect of the posterior femora dark; the antennæ black with the scape dark brownish. Eyes and ocelli dark garnet, the former with a discal blackish spot, not distinct; the pubescence indistinct on antennæ and body, giving the former an indistinct greyish appearance in direct light. The sculpture of head and thorax appears distinctly as a very slight, uniform and delicate roughening. The antennal flagella are about as long as the thorax. The sculpture appears rougher along the surface of the metanotum.

The male appears the same as the female, excepting the shorter, flattened, depressed abdomen containing a moderately large, brownish-yellow spot in the middle near base, and the slenderer, loosely-jointed, softly hairy antennal flagella, the pilose pubescence of which is distinct and yellowish grey.

When viewed with the naked eye, the parasites look like black gnats with long bodies, indistinct brown-yellow legs and indistinct clear wings which are folded along the back in the usual position for the Pteromalidæ. They appear a third smaller in size than *Pteromalus puparum* (Linn.) for instance to the naked eye and the sexes cannot be certainly separated without enlargement. Through a lens, however, the antennal and abdominal characters previously mentioned, together with the exserted genitalia of the male, allow them to be distinguished with readiness. To some extent, to

the naked eye, the species resembles some of the smaller species of Spalangia and more closely, *Pachycrepoideus dubius* Ashmead, but the bodies of the latter are noticeably shorter and more compact, the antennæ shorter and stouter.

Described from the following 324 specimens, all, with the exception of 50, now in the collection of the Illinois State Laboratory of Natural History and all reared from various house fly puparia, and those of two other Diptera, during the investigations of 1908 in the insectary of the office of the State Entomologist of Illinois at Urbana. Unless otherwise stated all of the specimens are mounted on tags.

(1) Eleven males of the parasite emerged singly on October 17, from 11 puparia of *Musca domestica* Linnæus which had been exposed in the insectary September 20 and 30; accession No. *10,231* 11 ♂'s. (2) On October 24 from the same lot of isolated puparia, there were removed 34 ♂'s, 83 ♀'s; accession No. *10,250*, 32 ♂'s, 81 ♀'s (2 ♂'s, 2 ♀'s — *Cotype No. 12,240*, U. S. N. M.). (3) 6 ♀'s from the same lot April 25, 1909; accession No. *41,082*, 6 ♀'s. (4) 2 ♂'s, 2 ♀'s, part of 7 ♂'s, 3 ♀'s reared October 2 from *Musca* puparia (see 11), parents of the next two numbers; accession Nos. *40,218*, 1 ♂, 1 ♀, and *40,246*, 1 ♂, 1 ♀. (5) 4 ♂'s, 19 ♀'s reared October 20 and November 7 from single *Musca* puparia in confinement, progeny of the single pair of accession No. *40,218* (see preceding); accession Nos. *40,219*, 3 ♂'s, 10 ♀'s and *40,269*, 1 ♂, 9 ♀'s (6) 1 ♂, 14 ♀'s reared October 20 to November 7 from 15 *Musca* puparia in confinement, progeny of the single pair of accession No. *40,216* (see 4); accession Nos. *40,217*, 1 ♂, 7 ♀'s and *40,268*, 7 ♀'s. (7) 3 ♂'s reared September 26 from three *Musca domestica* puparia formed from maggots in horse manure and exposed to parasitism in the insectary September 8 to 11; accession No. *10,111*, 3 ♂'s. (8) 4 ♂'s reared from four of the same host lot, September 27; accession No. *10,116*, 4 ♂'s. (9) 2 ♂'s reared from two of the same host lot September 28; accession No. 10,150, 2 ♂'s. (10) 2 ♂'s, 7 ♀'s reared from nine of the same host lot September 30; accession No. *40,153*, 2 ♂'s, 7 ♀'s. (11) 2 parthenogenetic females, reared from two puparia of lot 4 in preceding, parents of the following; accession Nos. *10,298* and *41,000*, 2 ♀'s. (12) 2 ♂'s reared October 24 from two puparia of *Phormia regina* (Meigen), parthenogenetic

progeny of the preceding number; accession Nos. *40,209* and *41,001*, 2 ♀'s. (13) 5 ♀'s, 9 ♀'s reared as in lot 4; discarded. (14) 3 ♂'s, 12 ♀'s+12 reared October 4 with several *Spalangia* and 1 ♂ *Pachycrepoideus dubius*, from 57 *Musca domestica* puparia, exposed to infestation September 8–11; accession No. *40,171*, 3 ♀'s, 12 ♀'s. (15) 22 ♀'s+8 reared from 30 of the same lot as 11, the same species present in larger numbers, October 11; accession, No. *40,205*, 22 ♀'s. (16) 1 ♀ collected in insectary around fly-breeding cages, September 10, parent of the next number; accession No. *39,965*, 1 ♀. (17) 7 ♀'s reared in confinement from 7 puparia of *Musca domestica* October 1, progeny of the single female of the preceding; accession No. *40,169*, 5 ♀'s. (18) 1 ♂, 1 ♂, each removed October 13 from single puparia of *Phormia regina* (Meigen) obtained from garbage at the city dumping-grounds, Champaign, September 23; accession No. *40,217*, 1 ♂, 1 ♀. (19) 1 ♀ reared from a *larva* of *Phormia regina*, collected in garbage at the city dumping-grounds, Champaign, October 21, and removed from the capsule containing the host larva on November 6; accession No. *40,258*, 1 ♀. (20) 2 ♂'s, 2 ♀'s reared from four *Musca domestica* puparia September 29, parents of the next number; accession No. *40,212*, 2 ♂'s, 2 ♀'s. (21) 2 ♀'s reared in confinement from two puparia of *Phormia regina* (Meigen), October 19, progeny of the preceding; accession No. *40,213*, 2 ♀'s. (22) 3 ♂'s, 3 ♀'s reared from six *Musca domestica* puparia, September 30, parents of the next; accession No. *40,211*, 3 ♂'s, 3 ♀'s. (23) 1 ♂, 1 ♀ reared in confinement from two puparia of *Phormia regina* (Meigen), October 19, progeny of the preceding; accession No. *40,215*, 1 ♂, 1 ♀.

Biological Notes.

The brief duration of the investigations and the lack of time and opportunity prevented an extensive study of the life-history and biology of this parasite, and because of its lesser abundance and the somewhat greater difficulty experienced in handling it in confinement, not as much was learned concerning it as in the case of *Nasonia brevicornis* Ashm. It is more sensitive than the latter, has an apparently limited number of hosts and is solitary; yet, notwithstanding these, with time and opportunity, its biological history could be learned with ease in the laboratory, as the females are not

at all adverse to ovipositing in confinement, as in the case of Spalangia and many other Chalcidoidea. But seemingly it is not as prolific and as general a parasite as is Nasonia.

We have not obtained positive data concerning the entire seasonal history of this parasite, but our observations indicate that it confines itself principally to the puparium stage of the house fly, following this single host throughout and hibernating in the host puparium as a larva, pupating and emerging early in the spring in time to attack the first host generation. The investigations concerning the house fly, and during which this parasite was discovered, did not commence until late in July, and the parasite did not appear, so far as we know, until the first week in September. From then on, until freezing weather commenced, it was comparatively common. It was reared from host puparia collected on September 23; and again, nearly a month later, from hosts collected on October 21, from a garbage heap then literally swarming with muscid maggots (Musca, Chrysomyia, Phormia); and from this last lot of puparia a few adults of the parasite had emerged by November 6. On October 21 hibernation had probably commenced, for although adult Spalangia were found to be rather numerous in the soil around the muscid puparia at the garbage heap, neither *raptor* nor *Nasonia brevicornis* were seen. Further, hosts collected on November 14, 1908, from the same garbage heap, then covered with snow, when confined in the warm insectary, produced both adult *raptor* and *Nasonia brevicornis* which emerged about a month later, their development having evidently been hastened by the warmth. Facts such as these, strongly indicate hibernation in the host puparia and analogy would lead to the belief that this species has a winter history somewhat similar to that found in *Nasonia brevicornis*.

As briefly as possible, we summarize the few special experiments conducted with this parasite in the laboratory.

I. An adult female captured in the insectary around fly-breeding cages, September 13, was at once confined in a vial with a single puparium of *Phormia regina;* oviposition was observed within the next 24 hours, after which the parasite was released. No emergences followed. However, the host was examined in March, 1909, and found to contain fragments of the host pupa, the dead larva of this parasite, its body blackened but still soft up to May 20 follow-

ing and its peculiar meconium. Hence, this parasite attacks *Phormia regina* in confinement.

II. *a.* On October 1, a pair of adults just reared from Musca puparia in horse manure were confined with 40 healthy puparia of the same host reared in confinement from maggots in garbage. Oviposition occurred and on October 20 following, four males and 19 females emerged as the offspring of the single female, making a total progeny of 23.

b. Another pair from the same source and emerging at the same time were similarly confined with 30 fresh Musca puparia reared from the maggots in garbage. Reproduction occurred and on October 20, one male and 14 female parasites emerged as the total progeny of this pair.

Hence in confinement, single females were able to kill 23 and 15 hosts respectively, necessarily laying eggs to the extent of those amounts.

III. A single female parasite captured around the fly cages in the insectary, September 10, was confined in a glass vial with 11 healthy puparia of *Musca domestica* reared from maggots in horse manure; the parasite was confined with the hosts at 11.50 a. m. the day of capture. As a result, on October 1, seven adult females had emerged, the total progeny; two of the remaining hosts died but examination disclosed no symptoms of parasitism; the other two produced 1 ♂ and 1 ♀ of the host on September 14.

IV. Eleven females reared from 11 puparia of *Musca domestica* in horse manure September 29–30, and isolated at emergence — hence virgin — were separately confined during September 30 with single puparia of *Phormia regina*. Reproduction occurred and in three cases single males resulted as the progeny of three of the virgin parents; adult hosts emerged in three cases and the remaining hosts died without showing symptoms of parasitism. Hence parthenogenesis occurs with this parasite, the unfertilized ova producing males. Here, there can be no doubt but that the females were unfertilized, mating within the puparium, obviously, being impossible.

V. *a.* September 29, two males and two females of the parasite reared from four puparia of *Musca domestica* on the same day, earlier in the morning, were confined with 15 puparia of *Phormia regina*. Oviposition was observed at 11.45 a. m., and doubtless

occurred again. The resultant progeny proved to be two females from two of the puparia, emerging on the 19th of October.

b. Experiment similar to *a*. The following day three pairs of the parasite from the same source as in preceding were confined with 17 of the same host puparia, the resulting progeny proving to be one male and one female, emerging on October 19 following.

The experiments indicate fecundity, give the approximate duration of the life cycle and establish parthenogenesis, which, however, remains to be verified. They also show the readiness with which the puparia of Phormia are attacked in confinement.

Habits and Biology in General.

As the observations on all points of the life history and biology of this parasite were necessarily desultory, they can be presented in no other way than one seemingly fragmentary. For convenience and brevity they are summarized or collected under the following headings.

A. *Nature of Parasitism.* In the 309 (77 ♂'s, 181 ♀'s, 51 undetermined sex) cases of parasitism which were isolated in small gelatine capsules with special reference to the nature of parasitism, of which all but nine of the hosts (4 ♂'s, 5 ♀'s of the parasites) were *Musca domestica,* every one yielded but a single parasite, which shows beyond doubt that the species is solitary in habit, even when — rarely — attacking comparatively large hosts such as Chrysomyia and Phormia are. In a critical examination of the hosts, after the emergence of the parasite, it was found that in nearly all cases they were considerably reduced in bulk, but not noticeably in length, recognizable as pupæ, flattened, along the abdomen especially, hardened, shrunken and blackened — not collapsed or eaten away — indicating that the larval parasite was attached to the external body-wall of the host, obtaining its nourishment by absorption through it. This indication has been proven to be a fact by several direct observations made on dissected hosts, known to be parasitized by this species, and the further fact established, namely, that the larval parasite has no particular choice as regards the portion of the body of the host to which it attaches itself or rather to which it becomes attached. The destruction of the host is more complete than with Nasonia, for some host pupæ are mere hollowed-out

shells of the venter, but less so than is the case with Spalangia. In a few instances the hosts were mere fragments, but the great majority were as has been described.

After emergence of the adult parasite, an examination of the host puparium reveals at first the shrunken and blackened remains of the host pupa lying in its natural position along the floor of the puparium and attached to it, usually along the dorsum of the caudal portions of the abdomen, the yellowish pupal cast of the parasite and then caudad of the host remains, lying upon the floor of the puparium, free, the peculiar, round-angled, dark meconium of the parasite larva; or the latter may be attached to the host remains as in Spalangia, there resembling a dark clot. As this meconium is characteristic, and can be readily distinguished from that of Spalangia, and hence forms an available means of identity when others are absent, by way of description it may be stated that, to the naked eye, it resembles a small solid, black-brown bead, about thrice the size of a visible grain of sand, resembling somewhat a coarse grain of powder, but not as irregular or as angular, measuring actually about .8 mm., its general outline convex and dome-shaped, the bottom flat, and the convex upper side, with a concavity, groove or impression along or in its center or at one end; this impression is quite often segmented, and as it is known that it is formed by the abdomen of the parasitic pupa which rests in it, the segmented appearance is due to the impression made in the then soft meconium by the incisions of the abdominal segments of the larva; the place of this groove is variable, and it may be absent, tending to show that the pupa of the parasite was not attached to it in the usual way; the edges of the impression are quite often acute or sharpened ridges; from above the meconium's outline is circular, with some irregular angulation; rarely it is quite irregular. It is much smaller in diameter — at least by a half — than the meconium of Spalangia which is wider and flatter, lozenge- or discus-shaped, and hence the two are readily distinguished on comparison. So far as the evidence goes, the manner or nature of the parasitism does not differ for sex of the parasite nor for species of the host. However, in four authentic instances, instead of the puparium stadium being affected, it was the larval stadium. The hosts in these instances were *Chrysomyia macellaria* and *Phormia regina* and the parasites emerged from single, nearly full-grown larvæ isolated in capsules.

B. *Emergence of the Adult.* When perfect and mature, having cast the pupal integument and rested, the adult parasite in order to obtain its freedom cuts a single rounded hole, measuring from 0.60 to 1.25 mm. diameter, through the puparium with its mandibles. This exit-hole varies in position but is usually cephalad or caudad and in the dorsal aspect. Its edges are ragged or serrated. It does not vary for sex or host and is not unusual. In rare cases the parasite may make as many as four exit-holes, obviously because of its failure to accomplish its exit readily, as is normal. So far we know of no characteristics distinguishing the exit-holes of this parasite from those of Spalangia or Pachycrepoideus.

In regard to the time of emergence. The two sexes appear almost simultaneously, but our rearing records indicate an earlier appearance of the male as is usual. This sex, in a cycle lot of the same age, may appear from 24 to 36 hours earlier than the females, but not all together, the time given referring to the individuals of earliest appearance. The tendency in development is for a more rapid maturity of the males, taking the sex as a whole.

C. *Oviposition; Number of Eggs Deposited.* The facts concerning this habit are not well known and our observations are briefly stated. In one of the two cases observed, the host being *Musca domestica* Linnæus, the position of the female was essentially the same as with *Nasonia brevicornis* Ashm.; the ovipositor was inserted into one end of the host dorsad and 90 seconds were occupied in inserting or boring the ovipositor into the host, and the ovipositor was fully inserted for 105 seconds. In the other case observed (September 9, 1908), the female stood lengthwise along the *domestica* puparium, along the median line dorsad, and inserted the ovipositor between two caudal segments; the antennæ and abdomen were moved slightly during the operation which lasted for seven minutes (6.15 a. m.); subsequently during the same day, this same female was observed making (apparent) oviposition into the same host, so that, though solitary, several ovipositions into single hosts may occur (confinement). As already stated, occasionally (rarely) the female may deposit into maggots, apparently when young, but it is a question how this occurs or under what conditions it could be accomplished.

Regarding the number of eggs deposited. But two observations of worth were made concerning this, as recorded on a previous page (experiment II.). Here two pairs of adults were given access to a

number of healthy hosts, allowing some range in choice as regards the number of progeny. In case *a*, 23 progeny out of a "possible" 40 resulted, and in case *b*, 15 progeny out of a "possible" 30 resulted. As these pairs were fresh and had not reproduced previously, the results at least give us some notion concerning fecundity of the species.

D. *Length of Life Cycle.* We know nothing concerning the duration of the different stages, and but little concerning the duration of the cycle as a whole. What has been learned, was obtained by experiments conducted in confinement and is summarized in the following table:

TABLE I. DURATION OF THE LIFE CYCLE IN *Muscidifurax raptor*, SEVERAL CYCLES, 1908.

Lot No.	Number of Progeny.	Eggs Deposited.	Adults Emerged.	Duration of the Cycle.	
				Days.	Hours.
1	5 ♀'s	Noon, Sept. 10	10 a. m., [1]Oct. 1	20	22
2	2 ♀'s	Noon, Sept. 29	Noon, [1]Oct. 19	20	0
3	2 (♂♀)	9 a. m., Sept. 30	3 p. m., Oct. 19	19	6
4	23 (4 ♂'s, 19 ♀'s)	Noon, Oct. 1	Noon, Oct. 20	19	0
5	15 (1 ♂, 14 ♀'s)	Noon. Oct. 1	4 p. m., [1]Oct. 20	19	4
Average				19	17

E. *Proportion of the Sexes.* Of the 288 reared specimens of this species concerning which the nature of the sex was recorded, there were 85 males and 203 females, or nearly two and a half times more females than males. This high preponderance of the females is unexpected in view of the natural history of the species, but parthenogenesis may account for it, following as it does no general law in the Hymenoptera. The figures given are for the whole total of the specimens reared by us, either artificially or from hosts obtained in nature and the proportions may be warped. Of the former — those bred in confinement, hence artificially — totalling 52, but

[1] Approximated to hours.

nine were males and the remaining 43 females, the preponderance being still greater; of the 236 specimens obtained from hosts collected in nature, 77 were males and 159 females; the preponderance is much less than in the other class, being but as two is to one, and we are inclined to believe it to be the true condition.

THE FOOD OF CALLIGRAPHA BIGSBYANA, A CHRYSOMELID BEETLE.

By Robert W. Hegner,

Ann Arbor, Mich.

All of the adult specimens and larvæ of *Calligrapha bigsbyana* secured for me, or that I myself have collected, have been found upon the long-leafed willow, *Salix longifolia,* and so far as I have been able to ascertain, they do not occur in nature upon any other species of plant. It was discovered several years ago that both adults and larvæ thrive equally well in the laboratory when fed upon leaves of *Salix amygdaloides* (Hegner, 1908).[1] The following experiment was undertaken to learn if *Salix longifolia* is preferred.

Larvæ that had been fed in the laboratory on *Salix amygdaloides* pupated on July 2, and the adults emerged on July 14. On July 15 two males and two females were placed in a stender dish containing three leaves each of *Salix longifolia* and *S. amygdaloides.* The beetles crawled over the bottom, sides and top of the dish as well as over the leaves, and if they had preference for either sort of leaves they were given ample opportunity to show it. The leaves of *S. amygdaloides* were attacked as quickly as were those of *S. longifolia,* and as much of the former was eaten as of the latter. The experiment was continued for a month, fresh leaves of each species of willow being supplied to the beetles every day, but in no instance was a preference for either sort observed.

Beetles that are kept in stender dishes usually lay their eggs upon the leaves, but sometimes they fasten them to the sides or top of the dish. The two females used for this experiment chose one kind of leaf as often as the other upon which to lay their eggs. Why these beetles are found only on *S. longifolia* in nature, though they show no preference for it in the laboratory, is a question still unsolved.

[1] Observations on the Breeding Habits of three Chrysomelid Beetles, Calligrapha bigsbyana, C. multipunctata, and C. lunata. Psyche, Vol. 15, pp. 21–24.

SOME EXPERIMENTS ON THE RESISTANCE OF GYPSY MOTH EGGS TO THE DIGESTIVE FLUIDS OF BIRDS.

By William Reiff.[1]

The subject of the present paper has already been referred to in a previous article published in one of the recent numbers of this journal. There I referred to the investigations of Alexander Bau who determined by numerous experiments that the eggs of certain species of Lepidoptera will pass out undigested, and still remain in a living state after a trip through the stomach and intestines of some species of birds. On this account I thought that Gypsy Moth eggs which have extremely hard chitinous shells, might readily withstand such a journey without damage. If this should prove true the sporadic diffusion of the Gypsy Moth in New England, which has hitherto been so mysterious, might find a partial explanation.

In selecting the birds used for these experiments it proved impossible to get native species and I was compelled to substitute foreign birds such as sparrows and finches. Altogether species belonging to the following four families were utilized:

Fringillidæ. (German Canary Bird, English Yellow Hammer and English Chaffinch.)

Turdidæ. (Japanese Robin.)

Bubonidæ. (Screech Owl.)

Columbidæ. (Carrier Pigeon.)

German Canary Bird.

One dispar egg cluster overwintered in outside temperature was divided into two parts early in March, 1910. One half was put apart for control while the other was separated into its individual eggs. The eggs were put into small crumbs of bread to which small pieces of cochineal were added for the purpose of tracing the eggs in the droppings of the bird. The food thus prepared was given to the bird early in the morning and had passed through the alimentary tract at the expiration of an hour and twenty minutes. All

[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 24.

the red excrement was collected the same afternoon and dried in the air for two days. To facilitate the hatching of the caterpillars from such eggs as might be contained in the excrement, this was carefully broken into small pieces. Seven eggs were found but each had the shell slightly injured by the bird's beak. The rest of the eggs had not been eaten but had been picked out of the crumbs of bread by the bird and thrown aside. The hatching of caterpillars from the control eggs began on March 21 and was completed two days later, but the seven eggs obtained from the excrement failed to hatch, having dried up.

In the following experiments the same precautions were taken, keeping control eggs from each cluster used and adding bits of cochineal so that this need not be mentioned in the case of the other birds.

English Chaffinch

A bird of this species was fed in the same way but the eggs were not passed in the excrement until nearly three hours after feeding. The excrement was dried and broken up as before but not a single dispar egg could be found. These missing eggs were later found uneaten, having been cast aside by the bird.

English Yellow Hammer.

A specimen of this species was fed as before but the eggs were placed in living larvæ of the meal-beetle which had been cut open on the last four abdominal segments to insert the Gypsy Moth eggs. The bird was fed with these in the morning and after an hour and a half they were passed in the excrement of the bird. In this case twelve dispar eggs were found and no sort of injury could be detected on any of them. Other eggs fed in pieces of bread were cast aside by the bird and not eaten. Although the caterpillars from the control eggs hatched normally all those fed to the bird failed to hatch. These changed color normally but died with a nearly developed caterpillar in each egg.

Japanese Robin.

This bird was fed on eggs placed in meal-beetle larvæ as was done with the previous bird. The bird was fed late in the morning and an hour and a half later the eggs were passed in its red excre-

ment. Fifty-two eggs were found in this excrement and of these one hatched on the 23rd of March, followed by two on the morning of the 24th. A later investigation showed fully developed caterpillars in the eggs which had failed to hatch.

Screech Owl.

I at first attempted to feed the owl on bits of chopped beef in which eggs had been placed but it refused to partake of this mixture. It was then allowed to fast for a couple of days after which I offered it a freshly killed mouse into which one hundred and twenty dispar eggs had been placed through an incision made in the abdomen. This prepared mouse was given to the bird late one afternoon and was eaten during the following night. Late the next afternoon I found the red colored vomitings composed of the indigestible parts of the mouse and these contained a considerable number of dispar eggs, although none could be detected in the excrement. Altogether I found one hundred and twelve eggs, every one without any sign of injury. At the same time that the control eggs began to hatch some of those obtained from the owl gave forth caterpillars until altogether seven appeared. All of the others failed to hatch although they changed color in a normal way.

Carrier Pigeon.

This bird was fed upon a mixture of boiled pigeon-food to which the Gypsy Moth eggs were added. This was given to the pigeon late in the morning and after three hours had passed through its alimentary tract. Quite a number of eggs had been eaten by the pigeon but none was found in the excrement.

To sum up the details of these various experiments it is seen that Gypsy Moth eggs can withstand the action of the digestive fluids of birds belonging to at least two families, Turdidæ and Bubonidæ, without suffering any, or only slight, injury. In regard to the large family, Fringillidæ, also an insectivorous group, I am inclined to believe that these birds might also occasionally distribute Gypsy Moth eggs in spite of the negative results obtained in my experiments. Since the members of the pigeon family grind up their food in a gizzard filled with small stones it is very unlikely that Gypsy

Moth eggs could pass through their intestines without being destroyed.

In conclusion I wish to express my hearty appreciation to Prof. W. M. Wheeler, Prof. W. E. Castle and Dr. A. L. Reagh for their advice and assistance.

GEOMETRID NOTES.

By L. W. Swett,

Boston, Mass.

A New Cingilia.

Cingilia rubiferaria, sp. nov.

Expands ♂ 32-33 mm., ♀ 24-25 mm. Fore wings slate colored and semi-hyaline much thinner in texture than in *C. catenaria*, due to the much fewer scales and further apart, also more hairy. In some specimens the color is smoky brown but not so prevailing as the slate color. Front of head bright ocher as are tufts on thorax, but body is gray. First markings start on costa one fourth out, notched on each vein and black same as *catenaria* but not so distinct while it is always plain in the latter. Discal spot black, beyond extra discal lines runs zig-zag notched on the veins as *catenaria*. Black dots at ends of veins in fringe which is dusky. Hind wings same color as fore, with single extra discal notched line and dots at ends of veins. Beneath same as above only the lines are just visible which is not true of *catenaria* where they are strong. The female is strikingly different from the male being about one half the size and presents rather the appearance of a moth whose wings never fully expanded. The body is extremely heavy for the size of the moth and it is doubtful if it can fly. The markings are the same as the male except from the extra discal line on fore and hind wings the veins are black to outer border. Beneath same markings as above the black veins running from extra discal lines on fore and hind wings to inner margin.

I was at first inclined to place this as a melanic race of *catenaria*, it not being found in any place outside of Attean Pond, Maine, so Mr. Lucas tells me, and he examined the vicinity, nor did he take any *catenaria* at the same place. The small size female and the more hairy and thinner scaled wings would serve to separate it from *catenaria* and also the hairs appear broader under the microscope giving the wings a transparent look. This species was taken by Mr. Lucas at Attean Pond in northern Maine near Moosehead

Lake and was fairly plentiful flying up from the low bushes which surrounded the pond, there being no trees, but the females were crawling around probably due to the heavy body of the female, and very rare.

♀ type, Attean Pond, Maine, October 3, 1909, in my collection.

♂ cotypes, Attean Pond, Maine, October 3, 1909, distributed in the following collections: Boston Society of Natural History, William Reiff, G. H. Field, F. X. Williams, A. J. Crocker, University Museum of Harvard College and ten in mine, also in Brooklyn Institute Coll. from Dr. Hulst, Maine. ♀ cotypes, G. H. Field, William Reiff, and five in mine.

Mr. Guy Lucas turned up this interesting species in Moosehead Lake region, northern Maine, and I recognized it as being new and was going to describe it as *"lucasi"* when I took a trip to Brooklyn, N. Y., and saw my *lucasi* labelled *rubiferaria* Hulst from Maine. I looked up the literature and found Doctor Hulst never described this so I propose to keep it under the original name to avoid future controversy.

A NOTE REGARDING THE LIFE HISTORY OF ASCODIPTERON.

In a recent letter from my friend, Mr. F. Muir, he announces the sending of a paper which embodies results of his studies regarding the life history of Ascodipteron; and as it may be some months before his report can be published, it seems wise to offer this short preliminary notice. Mr. Frederick Muir, while engaged in collecting insect parasites in the Dutch East Indies, has made the following observations regarding the life cycle of Ascodipteron:

By the wings and the entire structure of the male, it proves to be very closely allied to the Streblidæ. The female is at first fully winged, but imbeds herself in the bat hosts, cuts off her wings and legs, and undergoes a post-imaginal metamorphosis which converts her into the flask-shaped grub originally described by Doctor Adensamer. This is brought about by the abdomen growing to an enormous extent, and completely covering the head and thorax. The proboscis of the female is greatly altered to enable her to penetrate the skin of the host, but its homology to the proboscis of the normal fly is perfectly clear. A more complete and detailed description of this bizarre type will follow in a later number.

THOMAS BARBOUR.

WESTERN LEPIDOPTERA. III.

Notes on Leptarctia californiae Walker.

By Karl R. Coolidge,

Palo Alto, California.

Some time ago while looking over the lepidopterological collection of Mr. J. G. Grundel, of Alma, Cal., I was struck by the great range of variation exhibited by *Leptarctia californiæ*, a rather common Arctian in the vicinity of San Francisco Bay. In one series of thirty-eight specimens, all from the same lot of eggs, hardly any two were at all alike, and no two exactly so, although *californiæ* is quite a plainly fashioned insect. The history of *Leptarctia californiæ* well illustrates the numerous troubles caused by a species much given to variation. The genus *Leptarctia* was established by Stretch, in his Zygænidæ and Bombycidæ of North America (p. 119), with *lena* Boisd. (=*adnata* Boisd.) and *decia* Boisd., both of which had been described in the genus *Lithosia*,[1] and a new species, which he called *dimidiata*. These forms he tabulated as follows:

Lower wings red	*L. decia*
Lower wings yellow	*L. lena*
Lower wings black	*L. dimidiata*

These three species we find depicted on plate 5, nine figures of *lena*, three of *decia*, and four of *dimidiata* being given. Stretch was evidently aware of the great amount of variation displayed in *Leptarctia*, as he remarks on page 121, under *L. lena*, "The wonderful variations of this species, show how necessary it is to have a long series of many insects before it is possible to determine the limits of the species. It is possible to select three or four types of the insect under consideration, so unlike each other, that in the absence of intermediate intergradations they might readily be considered specifically distinct; it was indeed a long time before I could satisfy myself of their identity, especially as the shape of the primaries is by no means constant, but the past summer has supplied so many intermediate links that there can be no longer any reasonable doubt." In 1855, however, Walker had described in the British Museum

[1] Five species of *Clithene* were also placed in the same genus by Boisduval Subsequently he remarks that the three former (*lena, adnata and decia*) "should perhaps be placed in a new genus near Nemeophila."

Catalogue Lepidoptera Heterochroa, *Nemophila californiæ*, which, as Stretch showed in his addenda and corrigenda (p. 240), is the same as *lena* Boisd., of which *adnata* Boisd. was a synonym, and as it has priority, *lena* must itself drop into synomical rank. Packard, Synopsis of the Bombycidæ of the United States, 1864, does not record any of the forms of *Leptarctia*. Stretch, under *L. lena*, wrote, "I strongly suspect that *Pltaarctia modesta*, Packard, is one of the many varieties of this species, although a specimen forwarded to Doctor Packard was returned with this query, 'What is it?' That it is congeneric is, I think, beyond doubt, as the peculiar thoracic markings are minutely given in the diagnosis of *P. modesta*." *Pltaarctia modesta* has, however, turned out to be only a form of *Parasemia plantaginis* Linn., another very confusing and variable species. In 1882 Grote (New Check List of North American Moths) gives *decia, lena* and *dimidiata* specific rank, with *californiæ* as a synonym of *lena*. This arrangement concurs with that of the list of the Brooklyn Entomological Society (1881), except that there is no mention of *californiæ* in the Brooklyn list. In 1881 Butler (Ann. Mag. Nat. Hist., Vol. VIII.) describes four more varieties, namely: *Stretchii, Boisduvalii, latifasciata* and *fulvofasciata*, his descriptions being based on the specimens figured by Stretch. He also retains as valid, the four names already proposed. In 1889 Prof. G. H. French published in the Canadian Entomologist, Vol. XXI., a paper on the "Preparatory Stages of Leptarctia californiæ Walker, with Notes on the Genus." In this paper all of these eight names are retained and in addition three new varieties are described. His arrangement may be summarized as follows:

Leptarctia californiae Walker.

Var. 1, *stretchii* Butler.
Var. 2, *boisduvalii* Butler.
Var. 3, *dimidiata* Stretch.
Var. 4, *albifascia* French.
Var. 5, *occidentalis* French.
Var. 6, *latifascia* Butler.
Var. 7, *fulvofascia* Butler.
Var. 8, *californiæ* Walker (Typical).
Var. 9, *wrightii* French.
Var. 10, *decia* Boisd.
Var. 11, *lena* Boisd.

Wood engravings are given of all these, together with a brief description of each form. Later writers have considerably cut down this list. Dyar (Cat. N. Amer. Lepid., 1902) lists but three forms as valid, these being *californiæ* Walker, *decia* Boisd. and *dimidiata* Stretch, the last two being placed as varieties. Holland, in his Moth Book (p. 121, 1903) places *lena, decia* and *dimidiata* as forms of *californiæ*. Thus, according to Dyar's list, we find again the three forms originally listed by Stretch, viz.: *californiæ* Walker (*lena* Boisd.), *decia* Boisd. and *dimidiata* Stretch.

The principal variation in the coloration of *Leptarctia californiæ* is in the secondaries, and the amount of black on the same wings is also very variable, from a few black points to uniformity. The variation even extends to the shape of the wings, the primaries being by no means constant. But it is the color variations that have brought *L. californiæ* to grief. The numerous varieties described were but individual variations of a single species as I can find all of the forms now recognized, with all intergradations, and in addition some which would certainly be worthy of being described as new if we were to go by some former standards, in this series of thirty-eight specimens, all from the same female. There is no doubt that we have but a single species of the genus *Leptarctia,* and the synonomy must stand as follows:

Leptarctia californiae Walker.

L. lena Boisd. 1868–'69.
L. adnata Boisd. 1868–'69.
L. dimidiata Stretch. 1872.
L. stretchii Butler. 1881.
L. boisduvalii Butler. 1881.
L. latifascia Butler. 1881.
L. fulvofascia Butler. 1881.
L. albifascia French. 1889.
L. occidentalis French. 1889.
L. wrightii French. 1889.

Stretch's remarks as to how necessary it is to have a long series of specimens before it is possible to determine the limits of a species, are particularly applicable to the protean members of the family *Arctiidæ,* of which the present species is a member, and the test of breeding will also be found to be an essential in such forms. *Leptarctia californiæ* is a rather common and wide-spread, though

somewhat local, species in California. It flies in the hot sunshine and seems to have a preference for open plots in wooded localities and along the roadsides. Professor French, in his paper already alluded to, has fully described the preparatory stages, there being but one brood a year. The food-plant is *Pentestemon* and Professor French has also fed the larvæ on *Ribes aureum* (Missouri Currant). In fact, the larvæ, like other *Arctians*, should prove to be quite general feeders. About San Francisco Bay, the adult insect emerges in late April and May. I have taken specimens in the Sierra Nevadas in Placer County, early in April.

REVIEWS.

Meunier, F. Monographie der Leptiden und der Phoriden des Bernsteins. Jahrb. d. konigl. Preuss. Geolog. Landenanstalt, Vol. 30, pp. 61–90, pls. 3–7. Berlin, 1909.

Meunier has given in the present paper descriptions of a number of species of Leptidæ and Phoridæ (principally the latter) occurring in Baltic Amber. Of Leptidæ, he recognizes two genera, *Leptis* and *Atherix*, seven species of the former and three of the latter, while in the Phoridæ three genera are recorded, *Phora, Aphiochata* and *Conicera* with fourteen, five and one species respectively. A comparison of the Phorids with recent species is rather difficult as their describer fails to mention many of the characters used for the separation of living forms, and lays great stress upon the comparative length of the tarsal joints which have not been hitherto extensively used in the classification of recent species.

There are several species, however, which are of especial interest. One, *Phora vincta* Meun. resembles greatly in the armature of the legs, species of the section *Dorniphora* Dahl, represented in both the American and the Malayan regions and the antiquity of this very minor group may explain its present wide distribution. Another, *Phora concinna*[1] has a peculiar flattened space on the hind tibia resembling a structure seen in certain Platypezidæ and Dolichopodidæ, but known among the Phoridæ only in three species of Aphiochæta (*A. smithii* Brues from America and *A. hirtiventris* Wood, and *A. derasa* Wood from Europe). Five tolerably well executed plates accompany the paper. C. T. Brues.

Banks, Nathan. Catalogue of Nearctic Spiders. Bull. U. S. National Museum, No. 72, pp. 80. Washington, 1910.

The little attention which systematic zoölogists have bestowed upon spiders in this country has undoubtedly been due in great measure to the

[1] Not the *Phora concinna* of Meigen (1830) which is a common European species, and entirely different from this one to which Meunier inadvertently gives the same name.

lack of a satisfactory catalogue of the group. This want has been filled in the present paper which should serve to call the attention of entomologists to this interesting group of Arthropods as well as to furnish them with some basis for taxonomic work. Although, as the author says, the catalogue presents no changes in nomenclature or classification it cannot fail to find a field of usefulness. Over 1300 species are included, belonging to nearly 275 genera in 28 families. C. T. Brues.

Howard, L. O. Preventive and Remedial Work against Mosquitoes. Bull. U. S. Bureau of Entomology, No. 88, pp. 126 (June, 1910).

This is a very complete account of the methods of mosquito prevention and destruction, and also contains a most instructive account of the results accomplished by mosquito crusades in a number of countries. Attention is called particularly to the fact that while the United States has done much toward exterminating mosquitoes in Cuba and the Canal Zone, measures relating to mosquito control within its own territory have been received with most deplorable indifference. C. T. Brues.

Snodgrass, R. E. The Anatomy of the Honey Bee. Bull. U. S. Bureau of Entomology, Tech. Ser., No. 18, pp. 162, fig. 57.

Aside from its especial usefulness to those interested in bee-keeping, the present account will be of value to many others on account of its most excellent illustrations and good descriptions of both the external and internal anatomy. The several parts of the paper are preceded by short general considerations of the structure of more generalized insects, which will serve to make the whole intelligible to those unfamiliar with insect anatomy. C. T. Brues.

Forbes, William T. M. A Structural Study of Some Caterpillars. Ann. Entom. Soc. Amer., Vol. 3, No. 2, pp. 94–132, pls. X–XX.

This is a systematic account of the characters present in the caterpillars of a large series of Lepidoptera belonging to many families. The major part of both text and illustrations deals with the comparative external anatomy of the head and the disposition of its setæ, although some attention has been given to the body setæ and armature of the prolegs. The author finds many useful classificatory characters and reaches a number of conclusions regarding the phylogeny and relationships of certain of families and genera. C. T. Brues.

Muttkowski, Richard A. Catalogue of the Odonata of North America. Bull. Public Museum, Milwaukee, Vol. I, pp. 207.

This important catalogue adds another group of considerable size to the series of North American insects which have been listed within the past few years and forms a welcome addition. Although the list primarily includes only Nearctic species found north of Mexico, a number of Mexican and all Cuban species are included, the southern limit being placed at 20° latitude, which, with a few exceptions, the author believes "closely approximates the natural zoogeographical limit." Such a treatment should avoid the omission of many species found in the southwestern states, as

these become more thoroughly explored. Nearly 500 forms are included with full synonymic references and also an extensive series of ethological references. Useful innovations are the citation of the present location of all types, so far as this could be ascertained; the mention of both actual places of capture of species and their zonal distribution; and the listing in a separate series of all fossil species. Matters of nomenclature have been dealt with by a conservative application of the International Zoological Code. C. T. Brues.

Hewitt, C. Gordon. The House Fly; A Study of Its Structure, Development, Biconomics and Economy. pp. ix, 195; pls. 10. Manchester, 1910. Sherratt and Hughes.

Doctor Hewitt has put together in the present book his three valuable papers on the house fly, which appeared in the Quarterly Journal of Microscopical Science during 1907, 1908 and 1909, and has added several short appendices dealing mainly with matters of practical importance. The appearance of this book just at present is very timely, when general interest is awakening in the economic importance of the house fly and it is to be hoped that Doctor Hewitt's fine work may find many appreciative readers. C. T. Brues.

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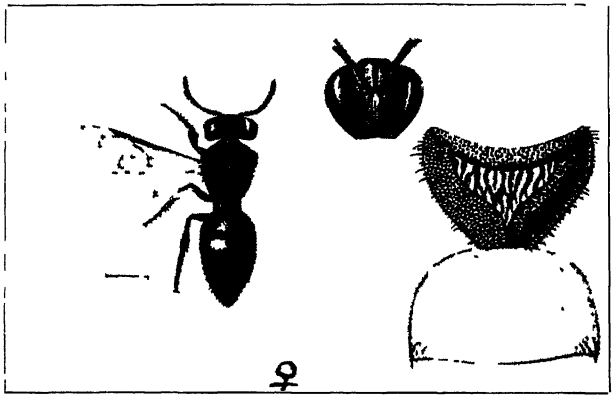

FIG 1 -- PROSOPIS AFFINIS SMITH

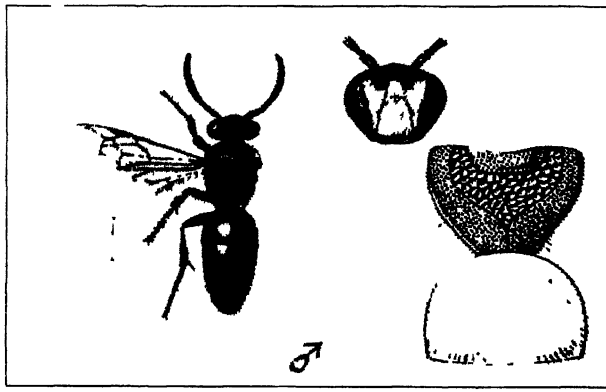

FIG 2 -- PROSOPIS BINGHAMI LOVELL

PSYCHE

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THE PROSOPIDIDÆ OF SOUTHERN MAINE.

By John H. Lovell.

Waldoboro, Maine.

The various species of Prosopis indigenous to southern Maine have been collected from June 16 to August 25. Of the eight local species enumerated in this paper only P. *pygmæa* and *P. modesta* are common, while *P. variifrons, verticalis* and *basalis* are very rare. Specimens of these bees have been taken most frequently on the flowers of *Aralia hispida* and the garden blackberry (*Rubus villosus*), to both of which they are common visitors. They are also often found on the inflorescence of the golden-rods, and less frequently on many other blossoms. The local species may be separated by means of the following key:

FEMALES.

Entirely black, a large species, 9 mm.....**basalis.**
Black with yellow marks.....1.
1. Collar black or unspotted.....2.
Collar with two yellow spots.....4.
2. Face-marks subtriangular, yellow spots on tubercles, and often tegulæ, 4-5 mm.....**pygmaea.**
Face-marks narrow, tubercles and tegulæ dark, 4-5 mm.....**saniculae.**
Face-marks bow-shaped, larger size, 6 mm.....3.
3. A transverse mark on clypeus, tegulæ spotted, marks nearly white..**variifrons.**
A transverse mark on clypeus, tegulæ dark, marks pale yellow.....**elliptica.**
Clypeus wholly black, tegulæ usually dark, marks yellow.....**verticalis.**
4. A yellow spot on base of costal nervure and on each tegula.....**ziziae.**
Base of costal nervure, or wing base, without a yellow spot, tegulæ usually dark.....**modesta.**

MALES.

Collar wholly black.....1.
Collar with two yellow stripes or spots.....5.

1. Scape dilated, larger size.....2.
   Scape not dilated, smaller size.....4.
2. Scape broader than long, cordate, concave beneath, the frontal half yellow, tubercles dark, 7 mm.....**basalis.**
   Scape longer than broad.....3.
3. Scape triangular in form with a yellowish white spot in front, the upward extensions of lateral face-marks obliquely truncated the inner angle prolonged to a point above the insertion of antennæ..**variifrons.** (*antennata*).
   Scape obconical, black, upward extensions of lateral face-marks diverging from the eye-orbit, and ending on a smooth, shining, rounded space above the insertion of antennæ.....**verticalis.**
4. Face below sockets of antennæ lemon yellow, upward extensions of lateral face-marks diverging from eye-orbit and club-shaped or rounded at apex, 4-5 mm.....**pygmaea.**
   Four separate marks upon face, a subquadrate spot on clypeus, a smaller one on supra-clypeal piece, and a stripe on each side, 4-5 mm.....**saniculae.**
5. Scape arcuate, a yellow spot on base of costal nervure and on each tegula, upward extensions of lateral face-marks truncate.....**ziziae.**
   Scape normal, unspotted, base of costal nervure or wing-base without a yellow spot, upward extensions of lateral face-marks obtusely pointed.....**modesta.**

Prosopis pygmaea Cr.

1869. *Prosopis pygmæa* Cr. (not Schenck), ♂, Pr. Bost. Soc. Nat. Hist. 12:272.
1896. *Prosopis pygmæa* Robt. ♀ ♂, Can. Ent. 28:137.
1901. *Prosopis pygmæa* Lov. ♀ ♂, Ent. News, 12:5.
1907. *Prosopis cressoni* Ckll. Ann. Mag. Nat. Hist. ser. 7, 20:131.

Specimens of the female were collected on the garden blackberry, June 19–25; Solidago, August 19–September 8; Aralia hispida, July 15; of the male on the garden blackberry, June 19–21; Solidago, August 9–25. A common and widely distributed species, reported also from Connecticut, Indiana, Illinois, and Colorado. At Falls Church, Va., it has been taken May 30 on chinquapin, and July 6 on Ceanothus by Dr. Nathan Banks. As the European *P. pygmæa* Schenck, according to Dalla Torre, is a synonym of *P. brevicornis* (Nyl.) Schenck, the long established specific name given by Cresson has been retained.

Variations in the yellow marks are common; in the female there is usually a spot on each tegula but it may be absent, occasionally there is a spot on the clypeus, the lateral face-marks may be reduced to a stripe or a spot, while in one male the tubercles

are dark. In the male the 1st abdominal segment may be nearly impunctate, or sparsely and finely punctured. In this species as well as in *P. ziziæ*, *P. modesta* and other forms mounted specimens sometimes have the marks red. At first I supposed that this was a natural variation in color, but I have recently ascertained experimentally that this change is caused by leaving the specimens for too long a time in the cyanide jar. When a number of wasps belonging to the genus Vespa were left in the cyanide jar for some weeks, on examination the yellow marks were found to have all changed to bright red. Specimens of *P. modesta* with yellow marks were then exposed to the action of cyanide of potassium, and in a few days they became red. Even dried specimens were similarly effected. It is important that this artificial change of coloration should be generally known since it might easily lead to erroneous conclusions.

Prosopis saniculae Robt.

1896. *Prosopis saniculæ* Robt. ♀ ♂, Can. Ent. 28:137.
1901. *Prosopis saniculæ* Lov. ♀, Ent. News, 12:5.

Three females taken on *Aralia hispida*, July 15–16. I have a male from Point Abbaye, Mich., collected by Morgan Hebard, July 24, 1903, for which I am indebted to Mr. H. L. Viereck.

Prosopis affinis Sm.

1853. *Prosopis affinis* Sm. ♀ (not ♂), Cat. Hym. Brit. Mus. 1:24.

Many attempts have been made to identify *P. affinis* Sm., none of which appear to have been correct. Fortunately the types are still preserved in the British Museum, and through the kindness of Col. C. T. Bingham I have obtained new descriptions of both sexes accompanied by very excellent figures. The description of the female is as follows:

"♀.—Black. Head: the sides of the face with a triangular yellow patch extending from the level of the base of the mandibles to a little above the level of the insertion of the antennæ; antennæ castaneous brown. Thorax: a medially interrupted line on the pronotum, the tubercles and a spot in front of the tegulæ yellow; wings hyaline and iridescent, tegulæ, stigma and nervures castaneous brown, the nervures of a paler tint than the tegulæ or stigma; legs castaneous brown, the coxæ black, the basal half of the tibiæ of the anterior and posterior legs and the basal third of the tibiæ of the intermediate legs yellow. Abdomen: the apical margins of the segments 1-5, obscurely castaneous. Head about as broad as the thorax, trans-

verse, more than twice as broad as long, very closely, finely and evenly granulate; mandibles coarsely rugose in the middle on the outer side; clypeus trapezoidal, much longer than broad and about half the width at its posterior margin from what it is at apex; space between the base of the mandibles and the eyes very short; the eyes narrow and elongate, the cheeks behind the eyes not much developed; front between the base of the antennæ triangularly raised, the surface flat; antennæ short and robust, the basal two or three joints of the flagellum moniliform; the ocelli in a shallow arch on the vertex. Thorax, closely, finely and evenly granulate, broadly oval; pronotum transverse very narrow; mesonotum with longitudinal parallel short impressed lines; scutellum crescentic; median segment short roundly and obliquely truncate, the triangular area at base coarsely longitudinally rugose; pro-, meso- and metapleuræ rather flat. Abdomen: comparatively massive, smooth, the basal segment with very sparse minute punctures, posterior segments with scattered erect hairs. Length of ♀ 6 mm.; expanse 11 mm. The labels on the specimens bear no precise locality— simply "U. S. America.' "

The more important characters in which the female of *P. affinis* Sm. differs from the female of *P. ziziæ* Robt., which was formerly identified as Smith's species, are the much broader head and the absence of a yellow spot on the base of the costal nervure. They also appear to differ in distribution. Smith described three species of Prosopis from North America: *P. basalis* was from Hudson's Bay and was collected by G. Barnston; *P. confluens* was from St. John's Bluff, East Florida, and was collected by E. Doubleday; while the label of *P. affinis* gives only "U. S. America" as the locality, the British Museum Catalogue gives the locality as "Hab. North America, (E. Doubleday, Esq.)," from which it may be inferred with much probability that it was collected in East Florida in the same locality as *P. confluens*. If this supposition is correct, then we may have been looking for *P. affinis* in a part of the country in which it does not occur. The characters and distribution of *P. ziziæ*, therefore, appear to differentiate it from *P. affinis*, though undoubtedly the species are closely allied.

Prosopis binghami sp. nov.

1853. *Prosopis affinis* Sm. ♂ (not ♀), Cat. Hym. Brit. Mus. 1:24.

The male assigned to *P. affinis* evidently does not belong to it, but is a distinct species. After a careful comparison of the male and female types Colonel Bingham writes under date of November 5, 1907, "I am disposed to agree with you that ♂ and ♀ *P. affinis* Smith belong to distinct forms." I take great pleasure in dedicat-

ing this species to Colonel Bingham in acknowledgment of his kindness in redescribing and figuring Smith's types.

"♂. Differs from the female (*P. affinis* which Smith regarded as the female of this bee.—J. H. L.) conspicuously in color of the abdomen, which is exactly the color of a peeled horse-chestnut, in the more slender shape of the body and in the head and thorax being clothed somewhat thickly with short, erect, whitish hairs. The more minute differences in color and sculpture are as follows: Clypeus and the raised triangular area above it, the tibiæ of the fore- and the tarsi of all the legs, yellow; the pronotum without the yellow transverse line above. Head slightly wider than the thorax not so long as in the female; antennæ proportionately longer, the basal joints of the flagellum not markedly moniliform. Thorax: the mesonotum without the impressed lines, the triangular space at base of the median segment very closely and coarsely punctured, not longitudinally rugose as in the female. Abdomen: basal segment with more minute and scattered punctures and on its basal half somewhat thickly covered with erect hairs. Length 6 mm; expanse 10 mm."

For the two excellent figures of Smith's types illustrating this paper I am indebted to Colonel Bingham. Fig. 1. represents the female of *P. affinis*, and Fig. 2 the form wrongly supposed by Smith to be the male of this species, to which I have given the name *P. binghami*.

Prosopis ziziae Robt.

1896. *Prosopis affinis* Robt. (not Smith), ♀ ♂, Can. Ent. 28:136.
1896. *Prosopis ziziæ* Robt. Can. Ent. 28:136. (Proposed as an alternative name.)
1898. *Prosopis ziziæ* Ckll. ♂, Ent. 31:187.
1901. *Prosopis affinis* Lov. ♀ ♂, Ent. News, 12.6.
1904. *Prosopis ziziæ* Robt. ♀ ♂, Can. Ent. 36:274.

This species occurs throughout the northeastern states, and I have before me specimens of both sexes taken at Falls Church, Va., by Dr. Nathan Banks. I am not aware that it has ever been reported from Colorado, New Mexico, or the extreme southern states. It is not a common species in this locality. The female has been collected on the garden blackberry, June 24–25; Solidago, August 9–20; male on the garden blackberry, June 24; and Solidago, August 9–21. This species has been repeatedly identified as *P. affinis* Sm., but as has already been shown the two forms not improbably occupy different areas.

Prosopis modesta Say

1837. *Hylæus modestus* Say, ♀ (not ♂), Bost. Jour, Nat. His. 1:392.
1859. *Hylæus modestus* Lec. ed. Say's Writ. 2:771.
1869. *Prosopis affinis* Cr. ♀ ♂, Pr. Bost. Soc. Nat. Hist. 12:270.
1882. *Prosopis affinis* Prov. ♀ ♂, Faun. ent. Can. Hym. p. 727.
1901 *Prosopis modesta* Lov. ♀ ♂, Ent. News, 12:5.

Say's description of *P. modesta* is so brief and indefinite that the correct determination of the species has long been regarded as problematical. Unfortunately the types are no longer in existence. But the name has been so widely used that to reject the species as indeterminable is open to serious objection, since it will long linger on in lists and synonomies and continue to prove a source of error. The elimination of *P. affinis* Sm., greatly simplifies the problem, as it was with this species that *P. modesta* was most frequently confused.

In 1825, Say left Philadelphia, his native city, and joined William Maclure's community at New Harmony, in Indiana, where he remained until his death in 1834. His description of "*Hylæus modestus*" was published in 1837, so that it is probable that his specimens were collected in Indiana; and that, as he described only one species, they were common forms. Some years ago Mr. R. J. Weith collected for me at Elkhart, Indiana, a large number of bees, among which were three species of Prosopis: two of these were *P. pygmæa*, and *P. ziziæ*, and the third the most common form, I believe was the *P. modesta* of Say. Of the four or five other species of Prosopis occurring in this state there is little probability that any one of them can be Say's species, so that there would seem to be no objection to the acceptance of this identification of *P. modesta*.

Say's description of the female of *P. modesta* is as follows:—"♂. Black, opake; abdomen polished; hypostoma on each side with a triangular spot; collar with an abbreviated, transverse, yellowish line on each side; pleura with a yellowish spot under the humerus; wings hyaline, with blackish nervures; feet with whitish knees. Length over one fifth of an inch."

It will be noticed that there is no mention of a spot on the edge of the wing base, or on the tegulæ, so that the description cannot apply to *P. ziziæ*. To suppose that Say omitted to mention these marks would be a gratuitous assumption, the burden of proving which would rest upon the person suggesting it. I give below

the more important characters of the two sexes drawn from material collected at Elkhart, Indiana.

♀.—Length 6½ mm. Black, with lemon yellow marks on the face, collar, tubercles and legs. Head a little longer than broad, the clypeus minutely roughened with sparse very faint punctures; face above the insertion of the antennæ closely and finely punctured; the yellow mark on each side of the face triangular with a small notch opposite the socket of the antennæ, the upward extension pointed, but in a large Maine series variable in form. Two spots on the collar; mesothorax closely and strongly punctured; the tubercles yellow. Wings hyaline tinged with fuscous, nervures, stigma and tegulæ chestnut brown, or the tegulæ darker. Legs black, the anterior and intermediate tibiæ in front at base, and the entire basal half of posterior tibiæ yellow, tarsi chestnut brown. Enclosure on disc of metathorax distinct, the base coarsely ridged. Abdomen smooth and shining, the first segment very finely and sparsely punctured, the apical margins of the segments brownish.

♂.—Length 5½ to 6 mm. Clypeus, supra-clypeus, and sides of face lemon yellow, the upward lateral extensions obtusely pointed. Two spots on the collar, the tubercles, the anterior tibiæ in front, the intermediate and posterior tibiæ at base, and all the tarsi pale yellow. The antennæ black, the flagella light brown beneath. The face finely, the mesothorax strongly punctured; the enclosure of the metathorax coarsely and irregularly pitted. Wings nearly hyaline or tinged with fuscous, nervures, stigma and tegulæ chestnut brown, or the tegulæ piceous. First abdominal segment smooth and shining, finely and sparsely punctured.

The male described by Say does not belong to this species, and can not be determined with much certainty. *P. illinoiensis* Robt. is closely allied to *P. modesta*, but the male is described as having the first abdominal segment impunctate. *P. pennsylvanica* Ckll. has the marks chrome yellow. *P. modesta* is a very common species in the eastern states, and in a large series of specimens exhibits considerable variation. The interrupted yellow line on the collar is wanting in a few specimens, and rarely there is a yellow dot on the tegulæ. The males sometimes have a spot on the labrum and yellow lines on the mandibles; the punctation of the 1st abdominal segment also exhibits considerable variation. Specimens of the female have been taken on *Rubus strigosus*, June 16; *Aralia hispida*, July 16; Solidago, August 19; *Eupatorium perfoliatum*, August 25; of the male on *Rubus strigosus*, June 25; *Spiræa salicifolia*, July 16; *Aralia hispida*, July 28; and Solidago, August 19.

Prosopis variifrons Cr.

1869. *Prosopis variifrons* Cr. ♀, Pr. Bost. Soc. Nat. Hist. 12:270.
1869. *Prosopis antennata* Cr. ♂, Pr. Bost. Soc. Nat. Hist. 12:271.

It is probable that *P. antennata* is the male of *P. variifrons*. Both forms have been found in New Mexico and Colorado, but there is no record of the capture of the opposite sex of either species. The possibility that they represented the sexes of a singles species was pointed out by Professor Cockerell in the Entomologist, in 1898, and after examining specimens from both of the localities mentioned I am inclined to believe that this is the case. They agree in the following characters: deep black color with nearly white marks, immaculate color, tubercles and tegulæ spotted, longitudinal crenulate rugæ covering the entire enclosed area upon the metathorax, head and thorax opaque, finely and closely punctured, and color of the wings. The female often has a transverse trilobed mark upon the clypeus, but in some instances only the two lateral lobes are present and in others only the central lobe. At Waldoboro I have taken only one male on *Cratægus coccinea*, June 14, 1905.

Prosopis elliptica Kirby.

1837. *Prosopis elliptica* Kirby, ♀, Faun. Bor—Am. 4:266.

This species is very closely allied to *P. variifrons*. Through the kindness of Mr. H. L. Viereck I have three specimens, which I refer to *P. elliptica* ♀, collected by Morgan Hebard at Pequaming, Mich., July 1, 3, and 12, 1903. They differ from *P. variifrons* in having the marks lemon yellow instead of nearly white, while the tegulæ are unspotted. As in *P. variifrons* the collar is wholly dark, the tubercles spotted, the face-marks bow shaped, and there is a transverse mark on the clypeus sometimes reduced to a central spot. The differences are evidently varietal rather then specific and it is not improbable that *P. elliptica* replaces *P. variifrons* northward, as the type locality is British America. Until the male is definitely known its position can hardly be determined with certainty. I have taken one female at Waldoboro, July 2, which I refer doubtfully to this species.

Prosopis verticalis Cr.

1869. *Prosopis verticalis* Cr. ♂, Pr. Bost. Soc. Nat. Hist. 12:271.
1909. *Prosopis verticalis* Lov. ♀, Ent. News, 20:413.

I have taken one male at Waldoboro on an umbelliferous plant, July 14, which agrees with the description in all respects except that there is a small spot on each tegula. From Falls Church, Va., from Dr. Nathan Banks, I have one male and two females. In all three specimens the tegulæ are unspotted. The face-marks of the ♀ are bow-shaped and the collar is dark as in *P. variifrons*, but the mark on the clypeus is absent. The anterior and intermediate legs are wholly black, but the posterior tibiæ, are ringed with yellow. The rugæ of the enclosure upon the metathorax are longitudinal.

Prosopis basalis Sm.

1853. *Prosopis basalis* Sm. ♀ ♂, Cat. Hym. Brit. Mus. 1:23.
1869. *Prosopis basalis* Cr. ♀ ♂, Pr. Bost. Soc. Nat. Hist. 12:269.
1901. *Prosopis basalis* Lov. ♀, Ent. News, 12:4.

Female taken on the wild rose, July 10, 1905; and on *Aralia hispida*. The type locality is Hudson's Bay. A widely distributed species also reported from Colorado and New Mexico. I have a female from Point Abbaye, Mich., July 10, and a male from Pequaming, Mich., July 1, both collected by Morgan Hebard. The form of the dilated scape in the male is very remarkable, but no explanation of its ecological significance seems ever to have been suggested.

A GYNANDROMORPHOUS MUTILLID.[1]

By William Morton Wheeler.

On the first day of August, 1910, while I was collecting in a dry upland pasture near Colebrook, Litchfield County, Connecticut, my attention was attracted by a small Mutillid with wings only on one side It was running over the ground very rapidly, and on being captured proved to be a very handsome lateral gynandromorph of *Pseudomethoca canadensis* Blake, the right half of the body, including the appendages, being purely male and black, whereas the left half was largely of a rich red color and, except in a few insignificant details, purely female. Although the legs on the left side are stouter than those on the right the insect did not move in a circular but in a rectilinear path and was therefore able to compensate the difference in the strength of the appendages on the two sides of the body. The specimen was not dissected, since, owing to the small size of the abdomen and the hardness of the integument, I was sure of injuring the specimen and by no means sure of gaining an adequate conception of the structure of the reproductive organs. There can be little doubt, however, that these organs consist of an ovary on the left and a testis on the right side. The accompanying camera drawing of the insect in dorsal view, and of the head as seen from the front, together with the following description, will give an idea of the external structure:

The specimen is a little over 5 mm. in length. The two halves of the body, owing to the pronounced sexual dimorphism, are asymmetrical. The head is much smaller on the right than on the left side. The eyes are of nearly equal size; two ocelli are present on the male side, namely the anterior, or median, and the right lateral ocellus. The right mandible is tridentate, the left simply falcate. The right antenna is 13-jointed and much longer than the left, which is 12-jointed. The sharp line which separates the black coloration of the right from the red of the left side of the head begins at the middle of the occipital border, runs forward just a little to the left of the median ocellus, and terminates a little to the right of the middle of the clypeus. The clypeus

[1] Contributions from the Entomological Laboratory of the Bussey Institution Harvard University No 27

is black on both sides, the right mandible is black, the left red. The scape of the left antenna and the two basal joints of the funiculus are red. The tip of the second funicular joint, together with the third and fifth joints, are dark brown and the remainder of the funiculus is black. The palpi on the right side are black, on the left side red, with their terminal joints infuscated. The left side of the head bears on the lower side the peculiar tooth and carina so characteristic of the female, whereas these structures are lacking on the right side The left half of the thorax is typi-

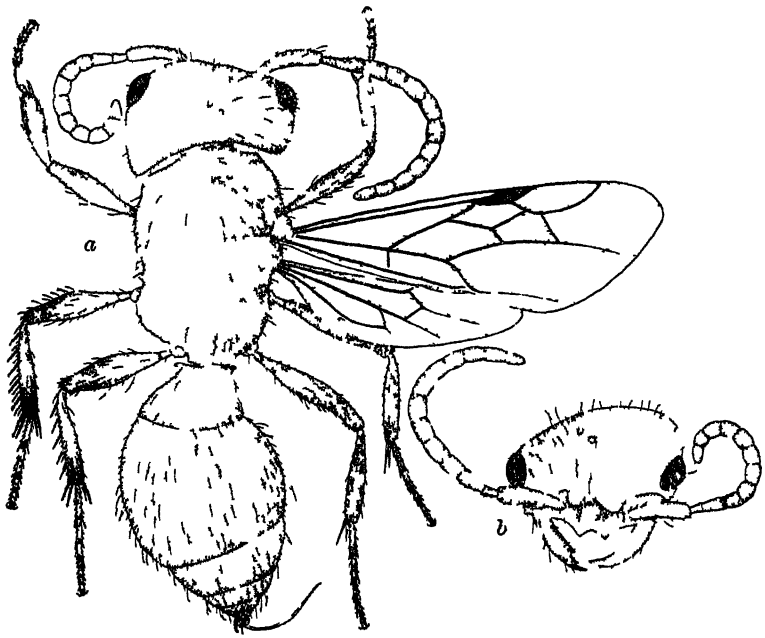

Fig 1 *Pseudomethoca canadensis* Blake, lateral gynandromorph, *a*, dorsal aspect, *b*, head seen from the front.

cally female, without sutures and deep red; the right half is somewhat longer and of the male type and black, with the sharp line separating the two halves rather sinuous or indentated towards the right in two places which correspond with the transverse suture between the mesonotum and scutellum and with that between the scutellum and metanotum. The epinotum is dis-

tinctly more convex and rounded on the right than on the left side. The tegula is well developed and the wings are normal on the right but completely lacking on the opposite side. The right legs are entirely black, except the spurs, which are white, and lack the spines on the extensor surfaces of the tibiæ. On the left side the legs have distinctly incrassated femora and somewhat clavate tibiæ. They are red, except the distal halves of the femora and tibiæ and the tips of the tarsal joints, which are black. The middle and hind tibiæ have the prominent spines so characteristic of the female on their extensor surfaces. The abdomen has six complete segments and apparently a vestige of a seventh on the right. It is asymmetrical owing to the enlargement of the second segment on the left, or female side. It is black, except for a large red spot on the left side of the middle line on the first and another similar but larger spot on the second segment. The line separating the male from the female half of the abdomen on the dorsal side runs a little to the right of the middle line but on the ventral surface it is very nearly median. The appendages at the tip of the abdomen are represented by the left half of the sting sheath, the left stylet and the left half of the gorgeret which is very long and slender, fully exerted and curved over to the right. The hypopygial area of the female is also recognizable on the left side. The male appendages are much less distinct, but it seems to be possible to detect what corresponds to the right stipes. The sculpturing on the two sides of the body corresponds to that of the respective sexes, the punctation being nearly the same on both sides of the head but decidedly coarser on the pro- and mesonotum of the right than on the corresponding regions of the left side of the thorax. The left pleuræ are concave and glabrous, on the right side they are convex and coarsely punctuate. The reticulate rugosity of the right half of the epinotum is coarser than that on the left half. The hairs on the right half of the head and thorax are distinctly longer than on the left half of these regions. Those on the entire male half are glistening white. They are also glistening white on the female half except on the second abdominal segment where those at the base and apex are black and those in the middle are yellow. The hairs on the legs are not appreciably longer or more abundant on the right than on the left side.

This description shows that the only particulars in which the left or female side departs from that of the normal female is in the coloration of the clypeus and the base of the third abdominal segment. Both of these regions are red in the normal female. At any rate, I find them to be of this color in some thirty specimens which I have examined, in twenty-eight collected by Mr. C. T. Brues at Woods Hole, Mass., several years ago, and in two taken by myself at Forest Hills, Mass., and Colebrook, Conn., during the past summer. In the mounted gynandromorphous specimen the third abdominal segment may be red at the extreme base, but it is drawn into the second segment so far that I am unable to determine its complete coloration.

Reference to the work of Dalla Torre and Friese on gynandromorphous Hymenoptera[1] shows that up to 1898 only one gynandromorphous Mutillid had been seen, and I have been unable to find that any others have been described within more recent years. The specimen mentioned by these authors is a *Mutilla europæa* L. var. *obscura* Nyl. which was described and figured by Maeklin in 1856.[2] This specimen, which was taken at Helsingfors, Finland, was a very perfect lateral gynandromorph, in which, however, the sex of the two sides was the reverse of that in the above described specimen of *Pseudomethoca*, being female on the right and male on the left side. Owing to the fact that the female *Mutilla obscura* has a dark head and the male a very similar coloration of the abdomen to that of the female the contrast between the two sides in Maeklin's specimen is less striking than in the one described above, and, as shown in his colored plate, shows strongly only in the thoracic region. There is, however, a distinct asymmetry of the abdomen, owing to the more bulging outline of the second abdominal segment on the female side. The specimen also shows the wings beautifully developed on the male side, and the strong contrast between the two antennæ.

Pseudomethoca canadensis is apparently a parasite on certain

[1] Die hermaphroditen und gynandromorphen Hymenopteren. Ber. naturwiss. med. Ver. Innsbruck, XXIV, 1898 (1899), pp. 1–96, 1 pl.

[2] Om hermafroditism bland insekterna, samt beskrifning ofver en i Helsingfors funnen hermafrodit af Mutilla obscura Nyl. Öfvers. af Finska Vetensk. Soc. Forhandl. III 1856, pp. 106–112, 1 pl.

of our burrowing bees of the genus *Halictus*. Some years ago Melander and Brues published an interesting account of *H. pruinosus* Robertson.[1] In this they showed that the most formidable enemy of the bee is the *Pseudomethoca*. They found that the female *Pseudomethoca* hangs about the burrows and attacks the female bee, and they have given a very entertaining figure and description of a battle between the bee and the Mutillid. Fully fifty specimens of the latter insect were taken from one square meter of *Halictus* colony during a single summer. In the dry pasture in which I found the gynandromorph there were many *Halictus* colonies, so that, in all probability, the specimen had passed through its larval and pupal development in one of the nests.

LIST OF SPHINGIDÆ OF AMERICA NORTH OF MEXICO.

By William Barnes, M. D., and J. McDunnough, Ph. D.

Decatur, Illinois.

Since Rothschild & Jordan issued their Revision of the Lepidopterous Family Sphingidæ in 1903, no attempt has been made to give a complete list of our North American species based upon this monograph. Holland in his Moth Book follows their work but his list does not pretend to be complete; as several new additions to our fauna have lately come under our notice, and as we have been made aware of several slight errors in the revision relating to North American species, it has occurred to us that an annotated list would perhaps be of service to collectors and future catalog makers. We have followed the revision as regards nomenclature in nearly every case, basing our remarks upon material in Coll. Barnes, which is practically complete in North American Sphingidæ. The list of localities is not intended to be exhaustive, but in most instances merely mentions localities from which we actually possess specimens.

For the benefit of those unfamiliar with Rothschild & Jordan's

[1] Guests and Parasites of the Burrowing Bee Halictus. Biol. Bull. V, No. 1, June 1903, pp. 1–27, 6 figs.

monumental work, we might state that the trinomial system of nomenclature here adopted is based on the fact that all species are more or less liable to geographical variation; taking the first geographical race described as the name for the whole species, the names of the different racial forms are merely added to this name without intervention of the term *var.* Thus *chersis oreodaphne* would be equivalent to *chersis var. oreodaphne,* and, since the first described race is as much a geographical variety as all others, the name *chersis chersis* must be used to indicate the typical race. Variations within the limits of a single race are termed forms; thus we have *P. modesta imperator f. t. kunzei* which indicates the summer form (kunzei) of the *imperator* race (Ariz.) of *P. modesta Harris.*

In conclusion we might state that we are thoroughly in sympathy with the system of nomenclature advocated so ably by Rothschild & Jordan. The making the first species mentioned under a given generic name the type of that genus may seem at first sight rather radical, but it at least possesses the advantage of being absolutely infallible, besides saving an enormous amount of misspent labor in searching through ancient and musty volumes, as is involved under the "restriction" principle, a principle only capable of being carried out with any fairly assured certainty of success when one has the entomological literature of the world at one's command. Surely a system which will assure a lasting stability and uniformity in our only too involved entomological nomenclature should be hailed with acclamation by all those who have the true welfare of entomology at heart; like a dose of purging medicine it may cause considerable discomfort for a time, but if the result will be to free our successors from all the difficulties we are at present contending with, then let us submit with cheerful spirits to any such slight personal inconvenience as it may entail.

List of Sphingidae north of Mexico.

Subfamily ACHERONTIINÆ.

Tribe ACHERONTIIC.E.

Genus **Herse** Oken.

(1) **H. cingulata** Fabr. N. Y. to Tex.
ab. decolorata Hy. Edw.

Tribe SPHINGICÆ.

Genus **Cocytius** Hbn.

(2) **C. antaeus** Drury
(a) **antaeus medor** Stoll. Fla.

Typical *antæus* is taken in the Antilles, not in N. America.

Genus **Protoparce.** Burm.
(3) **P. sexta** Johanns. U. S.
syn. *carolina.*

Holland mentions *P. occulta R. & J.* from Texas. We do not, however, know of any authentic specimens from this locality. It occurs in Mexico.

(4) **P. quinquemaculatus** Haw. Nearctic Region.
syn. *celeus.*
(5) **P. rustica** Fabr. N. Y. southward.
(6) **P. brontes** Dru.
(a) **brontes cubensis** G. & R. Southern Florida.

The typical *brontes* is confined to Jamaica, and Drury's citation of New York as habitat was doubtless due to an error. The form found in South Florida, of which Dr. Barnes has 4♂'s, is *cubensis* G. & R. and differs from *brontes* only in its clearer markings and slightly more variegated appearance.

(6a) **P. muscosa** R. & J. Tex., Ariz.

Recorded by Doll from Texas; 1♂ in Coll. Barnes from Prescott, Ariz. ex.—larva.

(7) **P. brevimargo.** Butl. Ariz.

This species has been placed by Rothschild & Jordan in the synonomy of *P. florestan,* which species is characterized by the possession of a pulvillus on the claw segment. Dr. Barnes has, however, recently received a single ♂ specimen from Huachuca Mountains, Ariz., in which the pulvillus is *not* present on any of the claws. According to Rothschild & Jordan this would place it under *P. corallina* Druce. Druce in his Biol. Cent. Amer. figures both species, and the specimen in question agrees so exactly in all particulars with his figure of *brevimargo* that we have had no hesitation in identifying it as this species. Until further material is forthcoming we consider it advisable to treat *brevimargo* as a

separate species. There is no doubt about the authenticity of the locality, and we are in hopes of receiving further specimens another year, which may throw some light on the synonomy of this difficult group.

Genus **Chlaenogramma** Sm.
(8) **C. jasminearum.** Guer. — Ohio, N. J., D. C.
Genus **Dolba** Walk.
(9) **Dolba hylaeus.** Drury. — N. Y., Md., Ill., Tex.
Genus **Dolbogene** R. & J.
(10) **D. hartwegi** Butl. — Ariz.

1♂ in Dr. Barnes' collection taken by O. Poling in Southern Arizona.

Genus **Isogramma** R. & J.
(11) **I. hageni** Grt. — Tex.
Genus **Ceratomia** Harris.
(12) **C. amyntor** Hub. — N. Y., Penn., S. Dak.
(13) **C. undulosa** Walk. — S. Dak., Ill., Penn.
(14) **C. catalpae** Bdv. — N. Y., Ky.
Genus **Isoparce** R. & J.
(15) **I. cupressi** Bdv. — Geo., Fla.
Not in Dr. Barnes' Coll.
Genus **Dictyosoma** R. & J.
(16) **D. elsa** Stkr. — Arizona.
Genus **Atreus** Grt.
(17) **A. plebeja** Fabr. — N. Y., N. J., Ala., Tex.
Genus **Hyloicus** Hbnr.
(18) **H. lugens** Wlk. — S. Western States?
syn. *andromedæ*. Bdv.

We do not know of any authentic record of this species having been taken in the United States, but Neumœgen mentions that a few specimens have been captured in the southwestern states. Possibly he was in error regarding the species.

(19) **H. geminus** R. & J. — Tex.

Two Specimens in Coll. Barnes labelled Galveston, Texas, received as *lugens*, correspond with this new species. It may be separated from the foregoing by the large black markings on underside of abdomen.

(20) **H. eremitus** Hub. — N. J., N. Y., Md., Ill.
(21) **H. eremitoides** Streck. — Tex.

This species, so frequently confused with *lugens* and *separatus*, may at once be separated from the former by its much smaller size and gray color, and from *separatus* by the fact that "the prothoracic tegulæ have no obviously yellow marginal spots." In Coll. Barnes are 4 ♂ and 4 ♀ from Kerrville, Texas.

(22) **H. separatus** Neum. New Mexico.

This species was long regarded as equivalent to *andromedæ* Bdv.=*lugens* Walk. It is however smaller and lighter in color than this form, and is most readily distinguished by the presence of a distinct yellow marginal spot on each side of the collar; these spots are always vestigial in the nearly allied species. Dr. Barnes possesses 2 ♂ and 3 ♀ from New Mexico.

(23) **H. istar** R. & J. Tex.

This is the largest species of the group and is represented in Coll. Barnes by 2 ♂ and 2 ♀, from Kerrville, Texas. Apart from difference in the genitalia it is separated from its near allies by the fact that the interspace between the black middle stripe of the prothoracic tegulæ and the black upper edge is dark brown, much deeper in color than the thorax and adjacent parts. It also lacks the black longitudinal line in the upper portion of cell on primaries.

(24) **H. chersis** Hbn.

(a) **chersis pallescens** R. & J. N. Mex., Ariz
(b) **chersis oreodaphae** Hy. Edw. Cal.
(c) **chersis chersis** Hbn. Eastern States.

A careful examination of the specimens in Coll. Barnes named *oreodaphæ* revealed the fact that with the exception of 2 ♀ they were all referable to the form *asellus* of *perelegans*. These 2 ♀'s belong to the new form, *pallescens*. Apart from their larger size and the marked difference in genitalia they may be most easily distinguished from *asellus*, to which they bear a strong superficial resemblance, by the fact that the gray color of primaries is much less even than in *asellus* and always shows whitish markings below the black dashes, exactly as in typical *chersis*. The broader white band distal to the black marginal line on primaries, as well as the faint black middle line on patagia by which Rothschild & Jordan differentiate *asellus*, are not always very

prominent in this species, but may, however, often be used as a means of separation.

(25) **H. vancouverensis** Hy. Edw.
(a) form **albescens** Tepp. Utah, Colo., Wash., B. C., Man.

The specimens in Dr. Barnes' Coll. do not seem to verify Bruce's statement that *vancouverensis* and *albescens* are two seasonal forms. We have specimens of *vancouverensis* dated May 8 (Colo.), May 10 (Wash.), June 16 (Colo.), June 9 (Manitoba), July 8, 24, (Colo.), and *albescens* dated May 1 and 5 (Colo., B. C.), June 24 (Colo.), and July 26 (Colo.).

(26) **H. libocedrus** Hy. Edw.
(a) **libocedrus libocedrus** Hy. Edw. Ariz.
(b) **libocedrus insolita** Lint. Tex.

Rothschild & Jordan separate these two geographical races by the color of the abdominal side spots, in *libocedrus* they are white, whilst in *insolita* they have a yellowish tinge. Lintner in his original description of *insolita* states, however, that "elongated patches (bands) of *clear white scales* extend over nearly half of each of the segments on its anterior half." Of the two specimens we have seen from Texas, both ♀'s, one has the spots of a distinct yellowish tinge, in the other they are almost pure white, so we are inclined to think that Rothschild & Jordan's diagnosis will hardly hold. The material of *libocedrus*, however, at our disposal is too much worn on the abdomen to allow of our forming a definite opinion in this respect.

(27) **H. perelegans** Hy. Edw.
(a) form **asellus** R. & J. Colo., Ariz.
(b) " **perelegans** Edw. Cal., B. C.

Apart from the difference in genitalia it is almost impossible to separate *asellus* from a small gray form of *chersis*. The form of the harpe is, however, so markedly different in both species that even a superficial examination of the genitalia serves to separate them. Whether *asellus* is a form of *perelegans* or may prove to be a good species we do not feel competent to decide. As far as our own experience goes, the two forms occur in different territory, which would at least point to a geographical sub-

species. *Asellus* seems fairly common in Colorado and Arizona, much more so than the form *pallescens* of *chersis*.

(28) **H. canadensis** Bdv. N. Hamp.
(29) **H. francki** Neum. Baltimore, Md.
Two specimens in Coll. Barnes.
(30) **H. kalmiae** Ab. & Sm. N. Y., Penn., Va.
(31) **H. gordius** Cram.
(a) **gordius oslari** R. & J. Colo.
(b) **gordius gordius** Cram. N. H., N. J., Va., Minn., Ill.

The Colorado race is easily distinguishable from the eastern specimens by its much greater size and the paler color of primaries.

(32) **H. luscitiosa** Clem. N. Y., N. J.
(33) **H. drupiferarum** A. & S.
(a) **drupiferarum drupiferarum** A. & S. Atlantic Subregion.
(b) **drupiferarum utahensis** Hy. Ed. Pacific States.

The western form *utahensis* is said to be whiter than the eastern form. Dr. Barnes has however a long series from Colorado, Oregon and British Columbia which it is impossible to separate from the ordinary *drupiferarum* of the east. In fact New York specimens in the same collection are considerably whiter than some of the western species. One ♀, however, from British Columbia corresponds exactly with Hy. Edwards' original description, having the primaries much more suffused with whitish gray, and the median band of the secondaries much broader, both of which points of difference do not hold for the remaining western specimens. We would be inclined to consider *utahensis* as merely an aberrant form of *drupiferarum* and not a geographical subspecies as treated by Rothschild & Jordan.

(34) **H. dolli** Neum.
(a) **dolli coloradus** Sm. Colo., Utah.
(b) **dolli dolli** Neum. Ariz.

We consider Rothschild & Jordan correct in treating these as merely geographical varieties of the same species. *Dolli* lacks the black submarginal line and the dashes of the posterior portion of the disk, corresponds, however, in all other respects with *coloradus*.

(35) **H. sequoiae** Bdv. Cal.
(36) **H. pinastri** Linn.

Dr. Barnes has two specimens of this species, one labelled California, the other Waghorn, Alberta. The Californian specimen lacks the black dashes usually found in *pinastri* and has further the brown crossbands of primaries more strongly developed than in the Alberta specimen.

Genus **Lapara** Walk.
(37) **L. coniferarum** A. & S. N. Y., R. I.
(38) **L. bombycoides** Wlk.
syn. *harrisii* Clem. Me., N. Y., Minn.
(39) **L. pineum** Lint.

Rothschild & Jordan regard this as an extreme aberrant form of *coniferarum*. We do not know the species, and believe that only two specimens have ever been taken.

Genus **Exedrium** Grt.
(40) **E. halicarniae** Stkr. Fla.

Subfamily AMBULICINÆ.

Genus **Protambulyx** R. & J.
(41) **P. strigilis** L.
ab. **rufipennis** Btlr. Fla.?

In Dr. Barnes' collection is a specimen labelled Palm Beach, Fla., received as *P. carteri R. & J.* This on a careful examination proved to be *P. strigilis, ab. rufipennis*. We cannot however vouch for the correctness of the locality label.

(42) **P. carteri** R. & J. Fla.

Rothschild & Jordan give Florida as a locality for this new species on the strength of a single ♂, received from the Kny Scheerer Co.

Genus **Sphinx** L.
(43) **S. cerisyi** Kirby.
(a) **cerisyi cerisyi** Kirby. Man., Ont., Me., N. Y.
(b) **cerisyi astarte** Stkr. Colo., Utah
(c) **cerisyi ophthalmica** Bdv. Cal., Wash., Nev., B. C.
(a) form **pallidulus** Edw.
(d) **cerisyi saliceti** Bdv. Ariz.

Two ♂'s in Dr. Barnes' collection labelled Catskill Mountains differ so decidedly from typical *cerisyi* in shape of wing and post-discal lunules, approaching in this respect, as well as in the browner ground color, the form *ophthalmica*, that one wonders if an error in labelling has not occurred somewhere. Both these ♂'s are further remarkable for the entire lack of the white dash at end of cell.

Saliceti Bdv. is a brown form from Arizona in which the second blue spot of the eye mark on secondaries is straight and not curved towards the third spot. All three blue spots are present and distinct from each other.

(44) **S. jamaicensis** Drury.	
(a) form norm. **geminatus** Say.	N. J., Ill.
(b) f. ab. **jamaicensis** Dru.	
(c) f. ab. **tripartitus** Grt.	

In Dr. Barnes' collection is a remarkable aberration lacking all markings on both primaries and secondaries with the exception of the apical lunules.

Genus **Calasymbolus** Grt.	
(45) **C. excaecatus** A. & S.	Ill., Colo., B. C.
(46) **C. myops** A. & S.	Mass., Pa., Ohio, Colo.
(47) **C. astylus** Dru.	N. Y., N. J.
Genus **Pachysphinx** R. & J.	
(48) **P. modesta** Harris.	
(a) **modesta modesta** Harris.	Ill., B. C.
syn. *occidentalis* Edw.	
(b) **modesta imperator** Stkr.	Colo., Ariz.
(a') f. t. **kunzei** R. & J.	

The form *kunzei* is the extremely pale summer brood of *imperator* Stkr.

Genus **Cressonia** G. & R.	
(49) **C. juglandis** A. & S.	N. Y., Mass., Ohio, Ark., Tex.

Subfamily SESIINÆ.

Tribe DILOPHONOTICÆ.

Genus **Pseudosphinx** Burm.	
(50) **P. tetrio** L.	Fla., Tex.
Genus **Erinnyis** Hbn.	
(51) **E. alope** Dru.	Fla.
syn. **edwardsii** Butl.	

(52) **E. lassauxi** Bdv.
f. **merianae.** Fla.

The typical *lassauxi* Bdv. occurs only in South America. The Florida form with the red area of hind wings prominent is f. *merianæ.*

(53) **E. oenotrus** Stoll. Fla.
(54) **E. crameri** Schaus. Fla.
(55) **E. ello** L. Fla., N. Mex.
(56) **E. obscura** Fabr. Fla., Tex., Ariz.
(57) **E. domingonis** Butl. Tex.
syn. *festa* Hy. Edw.

Rothschild & Jordan treat this as a good species.

Genus **Grammodia** R. & J.
(58) **G. caicus** Cram. Fla.

Tribe Sesiidæ.

Genus **Pachylia** Walk.
(59) **P. ficus** L. Fla.

In Coll. Barnes is also a specimen of *P. resumens* Wlk. labelled Florida. We fear however to add this species to the list as we cannot vouch for the authenticity of the label. Rothschild & Jordan, however, give Florida as a locality.

Genus **Madoryx** Bdv.
(60) **M. pseudothyreus** Grt. Fla.

In Coll. Barnes two specimens from Chocoloskee, Fla. Also reported by Laurent from Miami, Fla. (Ent. News, XIV, 59 & 305.)

Genus **Hemeroplanes** Hbn.
(61) **H. parce** Fabr. Fla., Tex.

Rothschild & Jordan give Florida as a locality for this species. In Coll. Barnes are three specimens labelled Texas. It probably occurs in all the southwestern states.

Genus **Epistor** Bdv.
(62) **E. lugubris** L. Ga., Fla.

Among a long series of this species in Coll. Barnes we also discovered a pair of *E. ocypete* L. the ♀ of which was labelled Florida. We refrain however from adding this species to the list until more authentic data can be secured.

Genus **Cautethia** G. & R.
(63) **C. grotei** Edw. Fla.
Genus **Sesia** Fabr.
(64) **S. tantalus** L.
syn. *ixion* L.
(a) **tantalus zonata** Dru. Fla.

The typical *tantalus* is the South American form. The form *clavipes* with protarsal segments 3–5 club shaped is the Mexican form and may possibly occur as a wanderer farther north. The form *zonata* with normal tarsi and reduced white spots on primaries occurs in Florida and the West Indies.

(65) **S. titan** Cram. Tex.

This species which has been so frequently confounded with *tantalus* is characterized by Rothschild & Jordan as follows: "Discal spots of forewing always simple, never divided, white scaling at anal angle of hind-wing more extended and denser, fore leg of ♂ with two conspicuous black tufts, one at end of femur, the other near the apex of the tibia." In Coll. Barnes two specimens from Shovel Mountain, Texas.

(66) **S. fadus** Cram. Fla.

Occurs as a wanderer in the southern states. The white discal spots of primaries are always partly double in this species.

Genus **Haemorrhagia** G. & R.
(67) **H. thysbe** Fabr.
(a) form **fuscicaudis** Walk. Southern States.
(b) form **thysbe** Fabr. Tex., Ill., Ark.
syn. *ruficaudis* Kirby.
(c) form **cimbiciformis** Steph.
syn. *uniformis* G. & R. = *ruficaudis* Walk.
buffalœnsis G. *floridensis* G.

We have adopted the synonomy of Rothschild & Jordan in dealing with this species; *fuscicaudis* is the southern form with dentate margins of wings and the abdomen from fourth segment on of a chestnut-red color. *Thysbe* is the well-known form with olive markings on last abdominal segments and dentate margins of primaries, whilst *cimbiciformis* has the margins of wings not dentate.

(68) **H. gracilis** G. & R.	
(69) **H. diffinis** Bdv.	
(a) **diffinis diffinis** Bdv.	Atlantic States.
(a′) f. vern. **tenuis** Grt.	
(b′) f. æst. **diffinis** Bdv.	
(c′) f. æst. **axillaris** G. & R.	
(b) **diffinis æthra** Stkr.	Me., Montreal, Que., Nipigon, Ont.
(c) **diffinis ariadne** n. nov.	Colo., Man.
syn. *senta* R. & J. (non Strecker).	
(d) **diffinis thetis** Bdv.	Pacific Subregion.
(d′) f. **thetis** Bdv.	Cal.
syn. *palpalis* Grt.	
(e′) f. **cynoglossum** Edw.	Cal.
(f′) f. **rubens** Hy. Edw.	Ore., B. C., Ariz., Utah.

We have been obliged to differ from Rothschild & Jordan in the above arrangement as an examination of Strecker's types has convinced us that his two species *æthra* and *senta* have never been properly recognized. In Group A., *diffinis diffinis*, we have followed the revision; the various seasonal forms of this eastern race are well known; *tenuis*, with non-dentate border of fore wing, represents the spring brood, whilst *diffinis* and *axillaris*, which only differ from each other in the more or less prominent dentation of the border on primaries, constitute two summer forms.

Æthra Stkr. has been placed by Rothschild & Jordan as a synonym of *axillaris G. & R.*, due probably to a statement of Smyth's (Ent. News, 1900, p. 585) that he has bred the form *æthra* from *tenuis* ova. While we recognize the fact that some specimens of *tenuis* tend to lose the dark abdominal band and develop a red apical spot, we consider the true *æthra* well distinct from such specimens. The type specimen, which we have examined, is from Montreal, Que.; besides this there are in the Strecker Coll. several very perfect specimens from Bangor, Me., and in Coll. Barnes 5 ♂♂, 1 ♀ from Nepigon, Ont. These all agree exactly with one another and differ from other eastern forms of *diffinis* in the roughness of the body squamation. The yellow of thorax and abdomen is not the pale yellow of *diffinis* or *tenuis* but rather an orange-brown, bordered narrowly with a pale yellow extending along patagia and sides of abdomen; the red apical patch is sharply defined and not continued along outer margin; the red of anal angle on secondaries is bright and the base of primaries

is also largely suffused with same color; the type specimen has a slightly dentate margin on primaries, not nearly so marked as in *axillaris;* the remaining specimens are almost smooth. The localities would point to the fact that this is a well-marked northern race, probably occuring in only one generation, our Nepigon specimens being taken July 8–15. The race has not the slightest resemblance with *axillaris.*

An examination of Strecker's type of *senta* has shown us that it is identical with the species hitherto known as *brucei French.* Rothschild & Jordan are in error in giving this name to the form with yellow centre to anal tuft dorsally. Strecker in his description distinctly states "anal tuft black," and the type agrees with the statement. In the Streck. collection this form with yellow centre is placed under *brucei Fr.* but this is evidently wrong, for the original description of this latter species states "terminal joint with its tufts, *both lateral and central,* jet black." As the type of *brucei* has been destroyed by Dermestes, the description is all that remains to us for purposes of identification; in Coll. Barnes, however, are several specimens labelled *brucei* and taken by Bruce himself in the same locality as the type specimen; these agree with *senta,* so we consider our reference fairly certain. As *senta Stkr.,* having priority, must be retained in place of *brucei Fr.,* we propose the name *ariadne* for the above form and append following description.

H. diffinis ariadne n. nov.

Palpi black above, pale yellow beneath; front, sides of thorax and patagia lemon yellow; centre of thorax darker, shaded with olive brown, which color extends over dorsal portion of abdomen to anal tuft; the black banding of 4th and 5th abdominal segments, characteristic of *tenuis,* not present; only in worn specimens does it seem to occur. Abdominal segments 1–5 broadly bordered laterally with black with traces of a few white scales intermixed; segments 6 and 7 somewhat lighter dorsally than preceding with pale yellow lateral tufts, extending sometimes to 5; anal tuft centrally orange yellow, laterally black; beneath black. Pectus yellow, legs black, with yellow tufts on tibiæ; abdomen beneath black with very slight sprinkling of yellow hairs on posterior segments, differing markedly in this respect from *senta,* in which the abdomen is grayish yellow beneath. Primaries hyaline with narrow brown-black terminal border, broadest at apex; the border is more or less suffused with rusty-red and contains a distinct apical spot of same color; base of wings deep red-brown with scattered yellow hairs; costal border slightly reddish with a few yellow scales. Secondaries, with very narrow border, distinctly reddish; anal patch reddish, intermixed with

yellow along inner margin. Beneath as above, slightly paler, base and costa of fore wing and costa of hind wing largely pale yellow; anal patch of secondaries broadly black along inner margin. Expanse 1½ in. = 38 mm.

Habitat: Denver, Colo., described from 14 specimens. Types, Coll. Barnes.

All the forms of *thetis* differ from the eastern races in having the anal tuft entirely black.

Diffinis thetis Bdv. is found typical in certain regions of California along the coast. It lacks all trace of red on wings, having the margins and patches deep chocolate brown. The form *cynoglossum* Edw. is similar to *thetis* but can at once be separated by the entirely black hind tibiæ, lacking the yellow hair of *thetis*. Holland's description of *thetis* (Moth Book, p. 64) is obviously incorrect; he seems to have confused this form with our *ariadne*. We consider *rubens* Hy. Edw. perfectly worthy of being retained as a form name; in fact it seems the most widely spread of the western forms, judging by the material at our disposal. It is readily separated from the two preceding by the red apical spot and more or less pronounced red shading at base of primaries and on anal patch of secondaries. The typical locality is Oregon and we have specimens from Victoria, B. C., which agree exactly with the type specimen. A long series from Utah differ from our British Columbia specimens in larger size, smoother squamation, and brighter red, while other specimens from Arizona are still larger, attaining a size of 50 mm. wing expanse. We hardly consider these forms, however, worthy of a separate name.

(70) **H. senta** Stkr. Colo., Utah.
syn. *brucei* Frch.

This species is most easily recognized by the entirely yellow abdomen on underside and black anal tuft. For the synonomy we would refer to our remarks under the preceding species.

Subfamily PHILAMPELINÆ.

Tribe PHILAMPELICÆ.

Genus **Pholus** Hbn.

(71) **P. anchemolus** Cram. Tex.

Dr. Barnes has received one specimen from Kerrville, Texas.

(72) **P. satellitia** L.	
(a) **satellitia pandorus** Hbn.	Ill., Tex.
(73) **P. achemon** Dru.	N. Y., Ill., Tex., Ariz.
(74) **P. typhon** Klug.	Ariz.

Dr. Barnes has several bred specimens received from his collector in Palmerlee, Ariz.

(75) **P. vitis** L.	
(a) **vitis vitis.**	Tex.
syn. *linnei* G. & R.	

This species, known since Grote & Robinson's revision as *linnei* is placed once more under *vitis* L. by Rothschild & Jordan. Any one interested in the elaborate proof as to the correct identification of Linné's species is referred to their work.

(76) **P. fasciatus** Sulzer.	
syn. *vitis* Dru. (non Linn.)	Tex.
(77) **P. labruscae** L.	Tex.
Genus **Ampeloeca** R. & J.	
(78) **A. versicolor** Harr.	N. Y.
(79) **A. myron** Cram.	Ill., Tex.
(a) f. **cnotus.**	Fla.
Genus **Darapsa** Walk.	
(80) **D. pholus** Cram.	
syn. *cherilus* Cram.	N. Y., N. J., Ill.
Genus **Sphecodina** Blanch.	
(81) **S. abbotti** Swainson.	N. J., N. Y.
Genus **Deidamia** Clemens.	
(82) **D. inscriptum** Harr.	N. Y.
Genus **Arctonotus** Bdv.	
(83) **A. lucidus** Bdv.	Wash., Cal.
Genus **Amphion** Hbn.	
(84) **A. nessus** Cram.	N. Y., Tex.
Genus **Proserpinus** Hbn.	
(85) **P. gaurae** A. & S.	
(a) form **gaurae** A. & S.	Tex.
(b) form **circae** Edw.	Ala.

We consider Rothschild & Jordan in error in placing *circæ* Edw. as a synonym of *gauræ* A. &. S. and their remark that "Edwards, considering the following species (*juanita*) to be the true *gauræ*, described a specimen of the present species as *circæ*"

shows a rather careless reading of the original description. Edwards knew both *gaurœ* and *juanita* and distinguished *circœ* from both these species by the fact that the secondaries were dull chestnut red with no traces of a darker marginal band. In Coll. Barnes are two specimens from Alabama corresponding with Edwards' description, and agreeing with the type specimen in Coll. Neumœgen; these we place for the present as *form. circœ* of *P. gaurœ*.

(86) **P. juanita** Stkr.
(a) **juanita juanita** Stkr. Tex.
(b) **juanita oslari** R. & J. Ariz.

We do not know the form *oslari* which differs from *juanita* in the paler color of wings and the vestigial character of the stigma of primaries.

(87) **P. clarkiae** Bdv. Colo., Ore., Cal.
(88) **P. flavofasciata** Walk.
(a) **flavofasciata flavofasciata** Walk. New England.
(b) **flavofasciata ulalume** Stkr. B. C.
(c) **flavofasciata rachel** Bruce. Colo.

A long series of *ulalume* from British Columbia in Coll. Barnes shows a considerable amount of variation; some specimens (especially ♀'s) show very little trace of the yellow band of secondaries, although none are so black as depicted in Strecker's original figure; others (mostly ♂'s) possess a clear orange yellow band on secondaries and are scarcely to be distinguished from *flavofasciata* from the east. We do not know the Colorado form *rachel* Bruce.

Genus **Euproserpinus** G. & R.
(89) **E. phaeton** G. & R. Cal.
(90) **E. euterpe** Hy. Edw. Cal.

Subfamily CHŒROCAMPINÆ.

Genus **Xylophanes** Hbn.
(91) **X. pluto** Fabr. Fla.
syn. *thorates* Hbn.

This is presumably the same species as that referred to by Laurent (Ent. News XIV, 305) under the name of *Thorates pergesa* (!). In Coll. Barnes is a long series from Florida.

(92) **X. porcus** Hbn.
(a) **porcus continentalis** R. & J. Fla.

Typical *porcus* is restricted by Rothschild & Jordan to Cuba. The form *continentalis* differs, apart from variation in the genitalia, in the less prominent stigma of primaries, as well as the more pronounced discal dots; the olive green shading outside the cell is also reduced. Dr. Barnes has one specimen *ex larv.* from Florida.

(93) **X. falco** Walk. Ariz.

Dr. Barnes has received three specimens of this species, bred by his collector in Arizona.

(94) **X. tersa** Linn. Fla., Tex.

Genus **Celerio** Oken.

(95) **C. gallii** Rott.

(a) **gallii intermedia** Kirby. Me, Colo, Wyo., B. C., Alta.
syn. *chamæneris* Harr.

(96) **C. lineata** Fabr.

(a) **lineata lineata.** N. Y., Ill, Colo., Ariz., Fla.

NOTES ON THE SPECIES OF ANYTUS GRT.

By John B. Smith, Sc. D.

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A recent re-arrangement of the genus made necessary by the accumulation of material has led to a somewhat closer study of the species, particularly with the view of fixing more accurately the standing of certain species. In Hampson's monograph *Hadena evelina* French, is included under the generic term, in my opinion erroneously; altho I am probably no nearer right in placing it with *Fishia.* The other species recognized in the monograph are *atristrigata* Smith, *privata* Wlk., with *monstrata* Wlk., *sculpta* Grt., and *plana* Grt., as synonyms, *profunda* Sm., and *obscura* Sm. More recently I have described *A. tenuilinea* from a single example received from Stockton, Utah.

Anytus atristrigatus Smith, is from Texas and differs from all the other species by having a conspicuous and continuous black streak through the submedian interspace from base to the outer

margin above the anal angle. The type of maculation is like that of *privatus*, but heavier, and the median lines are distinctly geminate. The types are both males.

Anytus privatus Wlk., better known as *sculptus* Grt., is of wide distribution throughout the eastern United States. While not one of the common species in most localities, it is by no means rare and flies in August and September. The squared, somewhat flattened thorax with its low divided creast recalls the Xyliniod genera and the type of maculation adds to this resemblance. But the wings are shorter and broader and the abdomen is not flattened. The colors are very light gray, resembling *Acronycta* so much that Walker described it once under the specific term *monstrata*, and the characteristic feature of the maculation is the indentation of the median lines in the sub-median interspace, supplemented by their connection through the black-edged and shaded claviform. The amount of black varies, so that there may be a very complete heavy bar dividing the median space, or there may be only a narrow line: the latter a somewhat rare form. There is little variation in other respects and the species once known is recognized with ease. The secondaries in the male are soiled white, outwardly powdery, with a blackish terminal line and some powdering on the veins. In the female the entire wing is a little smoky, an extra-median line is visible and usually also a discal spot.

The variety *planus* I have never seen. Mr. Grote describes it as having the median lines lost and the wing longitudinally shaded with whitish on median space, along internal margin, and diffusely beyond the reniform. None of the examples that I have seen even remotely approach this.

I have had under examination a series of 22 males and 25 females, most of them taken near Elizabeth, N. J., by Mr. Otto Buchholz, and they bring out nicely all variations that I have ever seen in the species.

Among my material, however, I picked out a series of five males and six females, that seemed different, and these I have named.

Anytus teltowa sp. nov.

Size and habitus of *privatus*, but darker throughout, the ground color of primaries being dark blue-gray instead of light ash-gray. In the male the secondaries

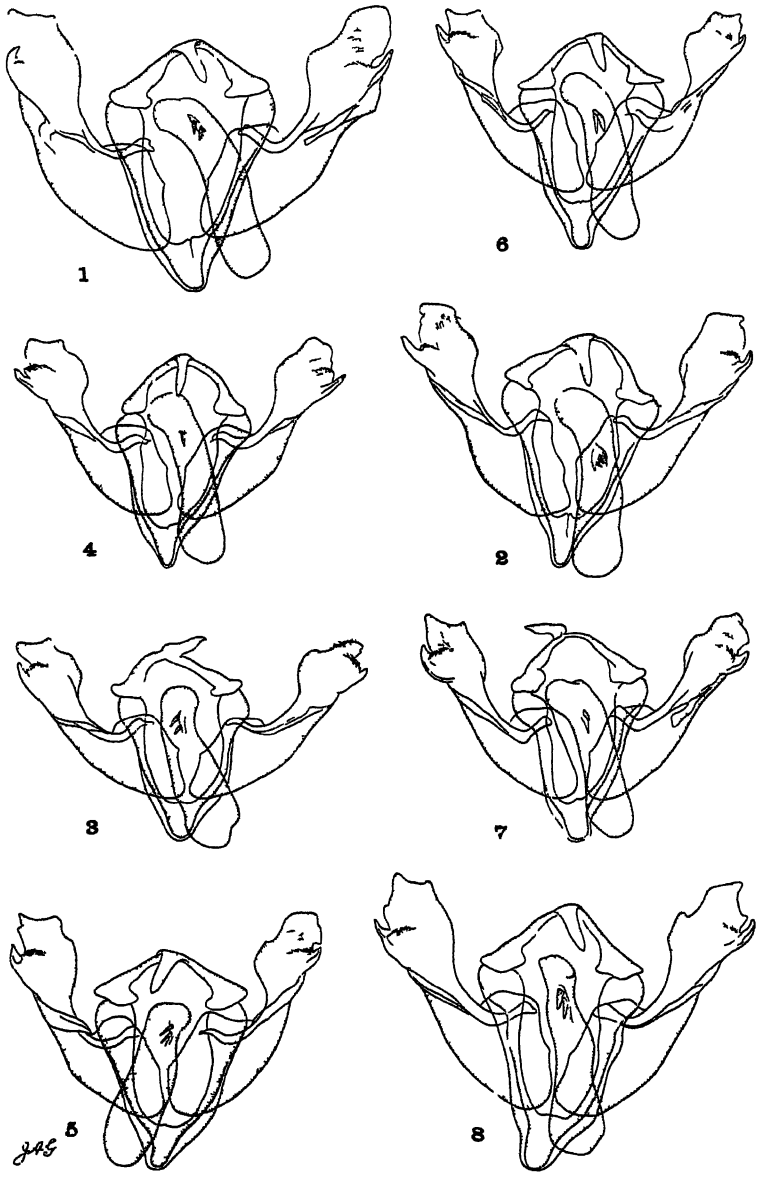
are like those of female *privatus*, while in the female they are smoky throughout, darker outwardly, with the exterior line and discal spot obscured. The black markings of primaries are heavier and more diffuse throughout, and the st. line is practically eliminated, the black shade which precedes the line in *privatus* continuing into and sometimes filling the terminal space.

Habitat: Hampton, N. H., IX, 20; Cohasset, Mass., IX, 3; Elizabeth, N. J., IX, 2-20; Lakehurst, N. J., IX, 27; Vineland, N. J., VIII, 29.

The structure of the genitalia in this genus so far as I have studied them, gives little help in the separation of the species. The harpes are very strong, highly chitinized, somewhat twisted and asymmetrical. As a result no two mounts lie in exactly the same plane and no two figures are entirely alike. There is, however, a somewhat marked difference in the width of the harpes as between *teltowa* and *privatus*, and a difference in outline which is especially marked in the right harpe as seen in the picture. Several specimens of *privatus* were studied, but only one of *teltowa*, and the figure given of *privatus* is like all the specimens of that form examined. *Atristrigatus* was not studied for lack of sufficient material.

Anytus tenuilinea Smith, was described from a single female sent in by Mr. Spalding of Stockton, Utah, and derives its name from the slender transverse lines and other markings. Other differences exist and are pointed out in the original description; but the creamy gray base and very narrow maculation are sufficient for its ready recognition. The interesting point is that I find in the material received from Cohasset, Mass., through Mr. Bryant, an almost exact duplicate of the type, also a female, under date of September 6. There were a dozen examples, representing both *teltowa* and *privatus*, but only this one female stood out from all the rest as *tenuilinea*.

In 1900 I described, in the Canadian Entomologist XXXII, p. 218, *Anytus obscurus* from a single Calgary male sent in by Mr. Dod, and *Anytus profundus*, from two Brandon, Man., males, sent in by Mr. Hanham. These species seemed to me distinct from the eastern *privatus* and from each other, though I realized that my material was scant. More material came in later, from the type and other localities, and I became distinctly doubtful of the validity of the separation. Sir George F. Hampson kept the



SMITH -- ANYTUS

species distinct in his monographic work; but Mr. Dod who has collected many examples, asserted that he had both forms represented in his captures and claimed that there was one species only.

A series of 28 ♂ and 23 ♀ from De Clair, Man., secured through Mr. H. H. Brehme, added to what I had from other sources. gave me a series of 65 examples of the two forms and, at first sight, separation seemed hopeless. More careful sifting, however, made matters easier, and I finally sorted out 5 ♂ and 4 ♀ as *obscurus*, all from Calgary, and the remainder, from Brandon, Cartwright, Miniota and De Clair, Manitoba, were all *profundus*. *Obscurus* is really well named and in the male differs obviously from *profundus* in a distinct brownish tinge, in the lack of contrasts, especially in the s. t. space, in the much more even, powdery suffusion over the whole wing, and in the lack of definition to the median lines.

Two males of *obscurus* and six of *profundus* were examined for genital structure and six figures, showing all noted variations, were made and are reproduced here for comparison. The harpes are asymmetrical and there is some little difference in each case; but the two *obscurus* stand out against the four *profundus* in the shorter, broader tip. The left harpe at tip shows in all *profundus* the little finger-like process at outer side below the level of tip which rises at once from the incision, while in *obscurus* the finger extends beyond the level of the border next adjoining. The differences are slight and perhaps not important; but for the present the superficial and other characters lead me to hold the two species as distinct.

EXPLANATION OF PLATE 11.

1. *Anytus privatus*. New York specimen.
2. *Anytus teltowa*· New Jersey specimen.
3. *Anytus obscurus*: Calgary specimen.
4. *Anytus obscurus*: Calgary specimen.
5. *Anytus profundus*: Brandon, Manitoba.
6. *Anytus profundus*: De Clair, Manitoba.
7. *Anytus profundus*: Meiniota, Manitoba.
8. *Anytus profundus*: Cartwright, Manitoba.

SYNONYMICAL AND OTHER NOTES ON DIPTERA.

By W. R. Thompson.

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I.

In Vol. II, No. 4 of the "Annals of the Entomological Society of America," a number of species and genera of North American Tachinids are described as new by Mr. C. H. T. Townsend. While working in the National Museum some time ago, I had occasion to make a careful study of the types of some of these forms, with the results given herewith.

Paragermaria autumnalis Towns.

This species has been described by Mr. D. W. Coquillett in Proc. Ent. Soc. Wash., VI., p. 186, 1904, as *Distichona auriceps*. The species is a well-marked one and there can be no question as regards the specific synonymy. The question of the synonymy of the three genera Distichona v. d. Wulp, Pseudogermaria B. & B., and Mr. Townsend's new genus Paragermaria, is a more difficult one and I do not care to express an opinion upon it at the present time. It must be noted, however, that in the specimens of this species which I have examined, there are a couple of hairs below the lowest frontal bristles and a row of similar fine hairs extends up the parafacials to a short distance below the upper ones just mentioned so that the parafacials cannot be termed bare. On this account *Distichona auriceps* Coqt., will not run to the genus Distichona in either the key to the genera in Mr. Coquillett's "Revision," nor in Mr. Adams' in Williston's "Manual," but will run out to Winthemia, from which it is easily distinguished by the reclinate ocellar bristles, the ciliate facial ridges, the broad cheeks, etc.

Sisyropa hemerocampae Towns.

Mr. Townsend gives as a synonym of this species, *Exorista griseomicans* Coq. (*non* v. d. Wulp), but has apparently over-

looked the fact that what is apparently the same form has been described already by Mr. Coquillett in the "Revision of the Tachinidæ," pp. 97–98, as *Exorista amplexa*. An examination of the series of specimens referred by Mr. Coquillett in the "Revision," to *griseomicans* v. d. Wulp, of those described by him as *amplexa*, and of the specimens included by Mr. Townsend under *hemerocampæ*, has disclosed the fact that the number of post-sutural macrochætæ is variable within the species, many specimens having three post-suturals on one side and four on the other. No other differences between the three forms are perceptible and consequently they must be referred to one and the same species. It is doubtful if the species is the one described by van der Wulp in the Biologia as *griseomicans*. His description omits several of the important characters but the legs are described as "black" whereas in all of the specimens of this form which I have examined, the tibiæ and often the femora as well, are reddish-yellow. Until it can be positively determined by an examination of van der Wulp's type that the species are not distinct the synonomy must stand as follows:

Exorista amplexa Coqt.

1897. *E. amplexa* Coqt., in Revision of the Tachinidæ, pp. 97–98.
E. griseomicans Coqt. (*non* van der Wulp), loc. cit., p. 98.
1909. *Sisyropa hemerocampæ* Towns., in Ann. Am. Ent. Soc., Vol. II, no. 4, p. 248.

Mr. Townsend gives no reasons for referring the species to the genus Sisyropa and until such reasons are forthcoming it must remain in the genus Exorista.

Eumasicera coccidella Towns.

The type of this species, which is a single female from Massachusetts, agrees perfectly with types and co-types of *Sturmia sternalis* Coqt., described from Missouri, and the forms seem to be without doubt identical. The genus Eumasicera certainly cannot stand since the species runs to the genus Sturmia in Mr. Townsend's own key to the genus Argyrophylax and its allies, in the "Taxonomy of the Muscoidean Flies," p. 98.

Rileyella Towns.

This genus is proposed by Mr. Townsend to include a single species,—*Frontina aletiæ* Riley, and as I understand it, to separate this form from *Frontina frenchii* Will., and *F. archippivora* Will., both of which have marginal macrochætæ on the first two abdominal segments in both sexes. After a careful comparison of the characters afforded by the puparia, which it may be remarked, are frequently of great assistance in the study of the Tachinidæ, and of the adult characters, including those afforded by the genitalia of the males, I have come to the conclusion that there is no good reason for the generic separation of *aletiæ* and *frenchii*. In the "Taxonomy of the Muscoidean Flies," p. 88, Mr. Townsend himself included *aletiæ* in the same genus with *hesperus* B. and B. which Mr. Coquillett in his "Revision" gives as a synonym of *frenchii*.

Cordyligaster septentrionalis Towns.

This form, described by Mr. Townsend from specimens from Plummer's Island, Md., is evidently *C. minuscula* v. d. Wulp, which was described from various localities in Mexico. A long series of specimens of this species is in the U. S. N. M. collections, and a careful study of the series and comparison with the types and co-types of Mr. Townsend's species, failed to disclose any specific differences. The description given by Mr. Townsend differs very little from that given by van der Wulp in the Biologia Centrali Americana, and there can be no doubt as to the specific identity of the two forms.

In the "Taxonomy of the Muscoidean Flies," p. 80, Mr. Townsend has described a new genus and species, *Oedemasoma nuda*, from a male specimen collected in Nevada, and remarks upon its close resemblance to *Wahlbergia brevipennis* Loew, to which Mr. Coquillett had referred this specimen with a query. The only differences which Mr. Townsend was able to find were slight differences in the position of the hind cross-vein, in the length of the petiole of the apical cell, and in the distribution of the pollen on the head and thorax. Through the kindness of Mr. Samuel Henshaw, I have been able to examine Loew's type in the Museum of Comparative Zoology in Cambridge. To all appearances Loew's type is somewhat greased, which undoubtedly accounts for the absence of the slight silvery pruinosity on the parafrontals

and anterior part of the mesonotum which Mr. Townsend describes as present in *Oedemasoma nuda*. Loew's specimen is a female whereas Mr. Townsend's is a male. In view of these facts it seems scarcely reasonable to separate them specifically. At Mr. Coquillett's request I drew up a description of the type of *Wahlbergia brevipennis* Loew, and forwarded it to him for comparison with the type of *Oedemasoma nuda* Towns., and he has come to the conclusion that the differences in the sex of the two specimens and the greased condition of Loew's type were sufficient to account for the differences which exist between them. Mr. Coquillett considers that the generic reference to Wahlbergia was correct, so that the generic synonymy will stand as follows:

Besseria Desvoidy, 1830.
Wahlbergia Zetterstedt, 1842.
Apostrophas Loew, 1870.
Oedemasoma Townsend, 1908.

In the other questions of synonymy discussed above Mr. Coquillett substantially agrees with me, and I wish to express my gratitude to him for his kind and courteous assistance in this and many other matters.

II.

In the keys to the genera of the Sarcophagidæ and Muscidæ in Williston's "Manual" there exists a slight but misleading error to which it may be well to call attention. If I do not mistake, these keys are adapted from those drawn up by Brauer and v. Bergenstamm in "Die Zweiflügler des k. k. Museums zu Wien." As Mr. Townsend has already pointed out in his "Taxonomy," the "genæ" or "Wangen" of Brauer and v. Bergenstamm do not correspond to the "cheeks," as the latter term is commonly understood, and as it is used in the keys to the Tachinidæ and Dexiidæ in the "Manual," but correspond to the "sides of the face" or "parafacials." The differences between the genera Calliphora and Lucilia, and between Phormia and Protocalliphora, are not in the presence or absence of hairs on the cheeks but on the sides of the face. Therefore, on page 343 of Williston's "Manual," the words "sides of the face," or "parafacials" should be substituted for "cheeks," in lines 2, 5, 8 and 11, and the same correction should be made on page 351, lines 4, and 5.

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THE AQUATIC CATERPILLARS OF LAKE QUINSIGAMOND.

By Wm. T. M. Forbes.

Worcester, Mass.

Lake Quinsigamond is situated in the center of Massachusetts, on the boundary between Worcester, Shrewsbury, and Grafton. It is long, resembling a river, with a number of shallow inlets, especially along the east shore. The main part of the lake is clear of vegetation, and most of the inlets have been disturbed by man, but beyond the "Stringer Dam," which cuts off the southeast corner, and in Flint's Pond, which is in all but name the south end of the lake, the water is mostly only three or four feet deep, and overgrown with the water lilies, Nymphæa and Castalia, Floating Shield, Floating Heart, Pond-weeds, Bladderworts, Pickerel weed, Elodea, and many other plants. This part swarms with Nymphulæ, of the following species:

N. maculalis, common especially over waterlilies, but flying freely and often found even on shore; also ab. *masculinalis*.

N. seminealis, equally common where Limnanthemum (Floating Heart) is dominant.

N. obscuralis. A single specimen.

N. allionealis, rather rare, and found only at a single spot, on the north shore of "Cuba" Island.

N. badiusalis, earlier than the preceding, except perhaps the last, and found mostly nearer shore; not very common.

N. gyralis, common, especially in Flint's Pond.

N. icciusalis, quite common.

Pyrausta nelumbialis, not common.

Larvæ were found of four species; maculalis and seminealis in large numbers, two of gyralis (?); and one of icciusalis.

Generic characters of the caterpillar. *N.* (*Nymphœella*) *maculalis* may be taken as a type, but *obscuralis* and *gyralis* (?) were com-

pared, also *nymphæata* of Europe. Head somewhat wider than high; small compared with width of body; front somewhat higher than wide, reaching more than two-thirds way to the vertex; the setæ far apart and high up, the punctures only a third as far apart as the setæ, and much lower; adfrontals slender, not entirely well defined from the epicrania; reaching vertex, but not quite completely separating front from epicrania below, with setæ close together and decidedly below the puncture. Labrum with *ii* rather higher than *i*, *iii* much below *iv*, moderately notched. Epicrania with *ii* near to adfrontals; with five ocelli, the posterior one being wanting. Antennæ with second joint four to seven times as long as wide, longer in Nymphæella and Paraponyx than in Hydrocampa, with one seta at about two-thirds its length, the long seta only about three-fifths as long as the joint; third and fourth joints equally long. Body very variable in shape in life, when preserved, short and broad, with tracheal gills in the subgenera Nymphæella and Paraponyx. Ventral prolegs rudimentary, with an ellipse of crotchets, alternatelyof two or three lengths, hardly interrupted in the first two genera, but broadly interrupted at the inner and outer ends in Hydrocampa. Anal prolegs with an ellipse of hooks in the former, broadly interrupted behind; in the latter, a single short straight band.

Spiracles of segments A2, 3, and 4, enlarged, the others rudimentary.

1. *N.* (*Nymphæella*) *maculalis* was very common wherever either of the waterlilies grew, and for some distance about on the shore males were plentiful. The male varied but little; but of the female, beside the typical ash-gray form some were pale brown, marked almost as in female *obscuralis* or with dark bands; some were gray with paler costa; and one or two white, with a few fragments of black lines (ab. *masculinalis*). Plenty of caterpillars were bred; and they are undoubtedly those noted by Dyar as *gyralis* (?).

The caterpillar forms a nest on leaves of the two waterlilies, Castalia and Nymphæa (Nuphar), and also on Brasenia, by cutting out a piece of the margin, and attaching it by silk to either the upper or under surface of the leaf. This nest is a broad oval, and when full sized is about an inch to an inch and a half long, and forms a rounded hump in the leaf when on the under side. (These were caterpillars of the first brood, in July.) When taken into

the house, into warmer water, they mostly cut out the portion of leaf on which their nests were made, and so made of then portable cases, much like those of *N. gyralis*, but filled with water. Pupation took place in the last nest, which was lined with a translucent layer of silk, and then showed a distinct central ridge from the outside. If the caterpillar was in a portable case (in the laboratory), it was anchored to the edge of a leaf. Late in August young caterpillars about an eighth of an inch long, or a little larger, had the same habits, but very soon the cases were cut away, as happened with the first brood in the laboratory, and the caterpillars were found to be only on the young submerged leaves. Apparently when very young they eat one epidermis and the parenchyma of the parts of the leaf forming their nests, but by the time they are a quarter of an inch long they feed only outside of the nest which is of uninjured pieces of leaf.

Eggs were laid in captivity, but not in a regular egg-mass. They were oval and flattened; .65 x .5 mm., and had no decided longitudinal ridge. Duration of stage about ten days.

Stage I. (From these eggs.) Slightly larger than N. gyralis? described below, with proportionately much larger anal setæ, without a trace of gills. Head nearly .3 mm.; length of large anal setæ 1 mm.

Stage II. Not seen; and no sign of leaf-mining was noticed.

Stage III (?). A transparent caterpillar, essentially like the full-grown ones. The maximum number of gill-filaments is two, and the anterior suprastigmatals and the last three pedals have but one. Length about 4 mm.; head .6 mm.

Stage IV. Length 4 to 6 mm.; head .4 to .56 mm.; maximum number of gill-filaments three.

Stage V. Length 6 to 10 mm.; head 1 to 1.5 mm.; maximum number of gill-filaments four. (Possibly two stages are confused here, or the wide range in size of head may be sexual.

Last Stage. Length fully extended may reach 25 mm.; head 1.5 mm. Transparent, the only appearance of marks being due to the internal organs showing through. Head pale chitin-yellow, with darker mouth-parts. The gills are 100 in number, each with from two to five filaments, as shown in the diagram.

Segments.	T2	3	A1	2	3	4	5	6	7	8	9
Anterior suprastigmatal	5	5	4	4	4	4	4	4	3	3	–
Posterior suprastigmatal	3	4	5	5	5	5	5	4	4	4	–
Lateral	3	3									
Anterior infrastigmatal			3	5	5	5	5	5	5	4	4
Posterior infrastigmatal	5	5	5	5	5	5	5	5	5	5	
Pedal	–	5	5	5	5	5	4	4	4	3	–

The characters that distinguish *N. maculalis* from *N. obscuralis* are, then, the equal number of filaments on the anterior and posterior infrastigmatals, and the fact that the seventh abdominal segment has one less pedal gill-filament than the more anterior ones. The filaments are also proportionately longer and the unbranched basal portion is longer. These characters will hold at least as early as the stage with two gill-filaments. From *Hydrocampa gyralis* (?) and *icciusalis*, it can be easily distinguished by the gills, and also by the spiracles, of which those on segments, 2-4, of the abdomen are equal, but minute (the size of the smallest in *N. gyralis* (?); and that of the first segment and the posterior ones are equal and rudimentary. The caterpillar becomes pale yellow just before pupation. Food Nymphæaceæ.

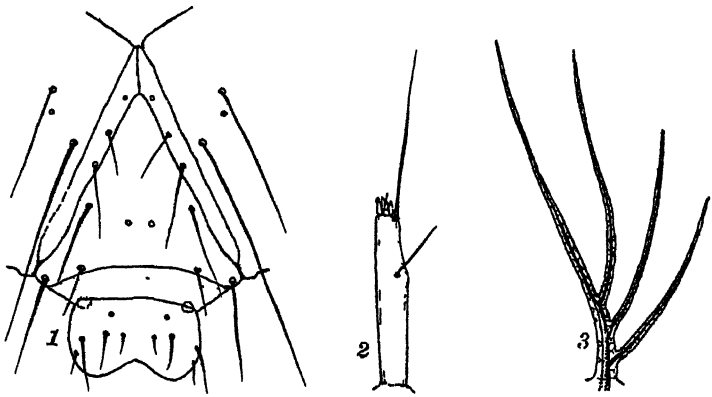

Fig. 1. Front and labrum of *Nymphula maculalis*.
Fig. 2. Antenna of *N. maculalis*.
Fig. 3. Tracheal gill of Nymphula.

Pupa similar in general form to that of obscuralis, as described by Dyar, but of the seven ridges near the tip of the abdomen beneath, only the central one remains, and the anal opening is not distinctly Y-shaped. The case for the hind legs varies considerably in length.

2. *N. seminealis*. Was not quite so common as the last; and the males did not rove as widely. No specimens were taken far from Limnanthemum.

♂. Whitish, powdered with dark brown, giving a chocolate brown effect. Transverse posterior line broad, even and white, strongly contrasting; running from the

costa to the submedian space, and then turning inward as far as the middle of the wing; preceded by an equal band of brilliant bronze. Subterminal fine, even, black, not reaching either costa or inner edge, and preceded by a broader line of grayish white. Subterminal space dark bronze; terminal space tawny, with a golden reflection. Fringe lead-colored. Hind wing not differing from that of the female. The wings are rather broader.

♀. Groundcolor, dull tawny brown, about the color of the subterminal space of the male, but not brilliantly bronzy. T. p. band grayish, not contrasting, subterminal line preceded by a less brilliant gray band; wings narrower.

Seminealis is an exceedingly close relative of *N. obscuralis* and *badiusalis*, and if *juncealis* is equally close, as Guénée's figure would suggest, Oligostigma will have to be widened to include the two former species, and will at best be a very subordinate subgenus of Nymphula, group Paraponyx. The slight truncation of the hind wings, given in the definition of Oligostigma, is shared by the other two. *Vittatalis* and the East Indian species have, however,[1] quite a different appearance.

Caterpillars were common, and were bred through. They come nearest to those of *N. obscuralis*, described by Hart, but the adult caterpillar has but four filaments to a gill, while *maculalis* has six. They have also a different food-plant; and none were found on Potamogeton which is common intermingled with the Limnanthemum. Four stages were seen, and the first was probably missed, as the head of the smallest found was too large for a normal Nymphula egg. It will probably resemble those of *maculalis* and *gyralis* (?) and be without gills.

Stage II. Maximum number of filaments one; width of head 4 mm. At this stage the caterpillar is a leaf-miner, lying close to the lower epidermis, and forms a somewhat trumpet-shaped mine.

Stage III. Maximum number of filaments two, the anterior subdorsals and stigmatals with but one; head .7 mm. The caterpillar now removes the lower epidermis as well as the parenchyma, and covers itself with a fragment of leaf. It forms a path continuous with its previous mine.

Stage IV. Maximum number of filaments three; head .9 mm. A case is now formed between a leaf and a piece cut out, or between two neighboring leaves. The red lower surface is eaten in a series of bands within the nest, forming a very characteristic marking; a habit which persists till the caterpillar is full grown, unlike maculalis, which after an early stage does not feed within the nest.

Last Stage. Maximum number of filaments four; head 1.3 mm. Habits as in the preceding stage, but the case is more often made between two complete leaves,

[1] I am indebted to Mr. W. D. Kearfott for the opportunity of seeing specimens of this genus.

or is occasionally detached and carried about, especially in captivity. In my full grown caterpillars the filaments were arranged as follows:

Segment.	T2	3	A1	2	3	4	5	6	7	8	9
Anterior suprastigmatal	4	4	3	3	3	3	3	3	3	3	–
Posterior suprastigmatal	3	3	4	4	4	4	4	4	4	3	–
Lateral	2	3									
Anterior infrastigmatal			3	3	3	3	3	3	3	3	3
Posterior infrastigmatal	4	4	4	4	4	4	4	4	4	4	
Pedal	–	4	4	4	4	4	4	4	4	3	–

From *N. maculalis* it may be distinguished by the fact that the anterior infrastigmatal has constantly one less filament than the posterior; and that the number of filaments in the pedal row is not reduced until the last one if at all. This distinction holds in the two-gilled and all later stages, and also applies to the other members of the subgenus, *obscuralis* and *stratiotata*.

Food Limnanthemum; will eat Potamogeton in captivity.

The pupa seems identical with that of *N. obscuralis*; but the hind-leg case is quite variable, sometimes as long as the body.

3. *N. obscuralis*. I have a single specimen of this species, caught at Worcester, but probably not coming from Lake Quinsigamond.

Ground color, whitish powdered with black-brown like male *semirealis*, but even duller, the powdering forming a darker median shade. T. p. line white, narrow, forming deep inward cusps opposite apex of cell and on vein 4, lost below vein 4; subterminal space rather warmer brown, but terminal space concolorous. Subterminal line sharply and deeply serrate on the veins. Wings entirely without bronzy reflections, but the hind wing is marked exactly as in *N. semirealis*.

4. *N. badiusalis*. Not common, with *N. allionealis*, and nearer shore. The caterpillar may possibly feed on some submerged plant.

5. *N. allionealis*. Not common, and only in a single station. Judging by the related European species *stratiotata* the caterpillar will feed on such a plant as Elodea, and will have one more filament in the posterior subdorsal gills than in either of the infrastigmatals.

6. *N. gyralis*. Was common enough, especially in Flint's Pond, to the south of the lake proper. It was the only member of its group (typical Hydrocampa) that was seen at the lake, so I place

with it, with some doubt, the following early stages. At any rate they do not seem to belong to the described species, *N. obliteralis*. The larvæ noted by Dyar as perhaps of this species are almost certainly those of *N. maculalis*.

Eggs. The eggs were quite like those of N. obliteralis, as described by Hart; .55 x .4 mm.

Stage I. (From these eggs.) Head dark brown, body pale yellow, not differing from the adult; without gills. Setæ proportionately longer than later, especially those at the posterior end, the subprimaries absent. Prolegs with fifteen crotchets, all of the same length, in a transverse ellipse. The alternation of lengths evidently appears with the second stage in Nymphula. Tracheæ empty. The head seems about the same as later in structure, but the antenna apparently lacks the terminal joint. Length at hatching 2.5 mm.; diameter of head .2 mm. They all died without eating, though provided with leaves of Nymphæa and Limnanthemum (laid on the latter), but they gathered on the Nymphæa leaf in numbers. Possibly in the first stage they may feed on submerged stems. Immediately on hatching they scattered and swam toward the light, spinning a tangle of silk threads.

Full-groun caterpillar. The full grown caterpillar is found in a nearly circular case, formed of two pieces of leaf of the yellow waterlily. It was large and roomy, and one piece of leaf was much larger than the other. It was filled with air. Before pupation the case was cut down to a diameter of less than 12 mm., and was more densely lined with silk. It was left freely floating. The caterpillar did not differ in structure from that of *N. obliteralis* (Dyar); with crotchets of ventral prolegs widely interrupted inwardly and outwardly; and anal prolegs with a single short bar of 12 crotchets. It was pale yellow, with light brown head without any dark band. The first abdominal spiracle was considerably larger than the fifth, and the second was intermediate in size between the first and the third. Diameter of head 1 25 mm.

Pupa. Deeper, brighter yellow than that of *N. maculalis* and *N. obscuralis*, the first of the open spiracles somewhat smaller than the other two. The hind leg cases reach but one third way to the tip of the body; the anal end apparently without any decided modification.

7. *N. icciusalis*. I had the good fortune to breed through a single specimen of this species, which was described, with some doubt, by Packard in the American Naturalist, xviii. The caterpillar is as described by him, so far as my notes go, with blackish brown head, and dirty gray body. It makes a case with decidedly rectangular shape, living the entire last stage and pupating in a single case. The figure by Packard exactly resembles my specimen. The caterpillar is extensible, like that of the other Nymphulæ and Packard's figure would represent it in full extension; when retracted it is no slenderer than the others. Before pupation the

case is anchored beneath the water on the submerged stem, and remains there. The moth evidently swims or walks up through the water before expanding, and so is more or less amphibious. My specimen was found on *Potamogeton*, in comparatively deep water, and did not eat Limnanthemum, so far as I could tell, though that is much more closely related to the food plant that Packard reported, Menyanthes. It was quite surprising to find that this moth, the one generally found nearest shore, had a caterpillar just as aquatic as that of *gyralis;* and a pupa that is actually submerged.

8. *Pyrausta nelumbialis*. The caterpillar was found on yellow pond lily; in the top of the petiole.

SYNOPSIS OF THE AQUATIC NYMPHULINE CATERPILLARS.

With tracheal gills; second and third abdominal spiracles equal
- Anterior and posterior infrastigmatal gills with the same numberof filaments.....(subgenus **Nymphæella** Grote)
  - Maximum number of filaments five; on Nymphæaceæ... ...**N. maculalis**
- Anterior infrastigmatal gills with one less filament
  - Posterior subdorsal gills with one more filament than infrastigmatals ..... (subgenus **Paraponyx** Hübner)
    - *N. stratiotata* of Europe and probably **N. allionealis** of America
  - Posterior subdorsal, and infrastigmatal, and pedal gills with the same number of filaments.....(subgenus **Oligostigma** Guénée)
    - With a maximum of six filaments in adult; usually on Vallisneria ..... **N. obscuralis**
    - With a maximum of four filaments; usually on Limnanthemum..... **N. seminealis**
    - Unknown .... **N. badiusalis**

Without tracheal gills
- Second abdominal spiracle decidedly smaller than the third; stout and flattened; head darker than body (subgenus **Hydrocampa** Latreille)
  - Head dark chitin-yellow; in a nearly circular case
    - Body whitish; thoracic tubercles more distinct than abdominal ones; head with a lateral dark brown stripe; on Potamogeton..... **N. obliteralis**
    - Body pale yellow; tubercles all similar; head without dark brown except in mouth-parts; on Nuphar (Nymphæa)...**N. gyralis** (?)
  - Head dark brown; body dirty gray; in an oblong case on Potamogeton and probably Menyanthes..... **N. icciusalis**
- Cylindrical and moniliform; head paler than body; forming a cylindrical or ellipsoidal case of a mosaic of Lemna plants.....**Elophila**
  - The American species have not been described.

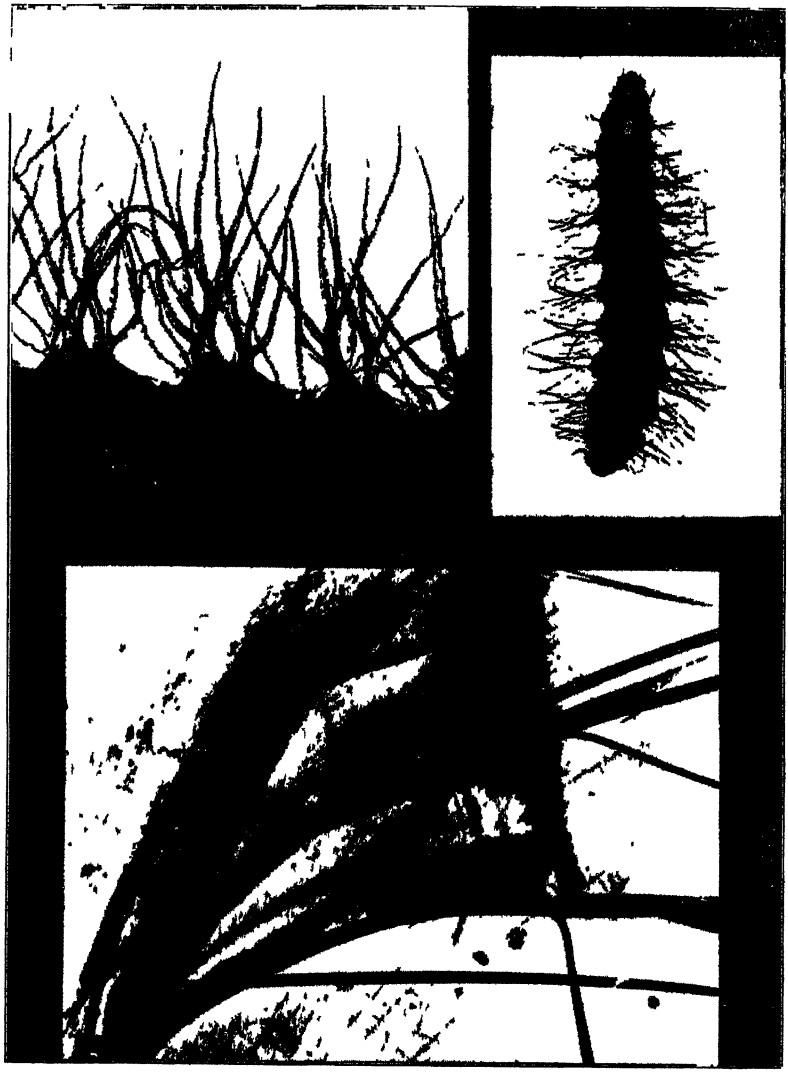

Fig. 4. Tracheal gills of penultimate stage of *N. maculalis*, photomicrograph.

Fig. 5. Penultimate stage of *N. maculalis* seen by transmitted light; alive but stupefied with chloratone.

Fig. 6. Cocoon of *N. icciusalis* on submerged stem of Potamogeton; enlarged about two times.

SYNOPSIS OF THE PUPÆ OF NYMPHULA.

The three open spiracles equal in size; ninth abdominal segment with a median longitudinal carina below.

With but one median longitudinal carina .....(subgenus **Nymphæella**

Cocoons on Nymphæaceæ..... **N. maculalis**

With seven longitudinal carinæ on a transverse ridge....(subgenus **Paraponyx**

Cocoons floating { on Vallisneria, etc.....**N. obscuralis**
on Limnanthemum..... **N. seminealis**

Unknown, possibly submerged.....**N. badiusalis** and **N. allionealis**

The first open abdominal spiracle distinctly smaller than the other two; no distinct median carina on ninth segment below.....

(subgenus **Hydrocampa**

Cocoon floating, nearly circular

Pupa pale yellow; first open spiracle much smaller than the other two; Potamogeton..... ..... **N. obliteralis**

Pupa bright yellow; first open spiracle hardly smaller than the other two; Nymphæa..... **N. gyralis** (?)

Cocoon submerged, oblong; first open spiracle much smaller than the other two; on Potamogeton and Menyanthes.....**N. icciusalis**

Unknown..... **N. ekthlipsis**

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SOME ADDITIONS TO THE DIPTERAN FAUNA OF NEW ENGLAND.

By Charles W. Johnson.

Boston Society of Natural History.

Pogonosoma dorsatum Say.

A specimen of this species was obtained by Mr. F. A. Sherriff at the base of Mt. Washington near Fabyan, N. H., July 7, 1910. I am not aware that the species has been collected east of the Rocky Mountains since it was described by Say from "near Philadelphia." It has been recorded from Washington (Williston) and Idaho (Aldrich). Specimens are in the writer's collection from Bear Creek Cañon, Colo., June 8, 1897 (Oslar), and Estes Park, Colo., July, 1892 (Snow).

Pogonosoma melanoptera Wiedemann.

In the collection of the American Museum of Natural History is a specimen of this species collected by Prof. W. M. Wheeler at Woods Hole, Mass., July 18. The distribution of the species would indicate an austral form. It has been recorded from Florida (Williston), South Carolina (Schiner), Maryland (Mus. Comp. Zool.) and New Brunswick, N. J. (Dr. J. B. Smith). Specimens are in the writer's collection from Alabama, Pendleton, N. C., June 7, 1895, and Philadelphia, Pa., July 5, 1898.

Ceraturgus nigripes Williston.

One specimen collected on the side of Mt. Equinox, near Manchester, Vt., June 5, 1910, at an elevation of about 2,000 feet.

The specimen agrees with the description of *C. nigripes*, except in two minor details. The wings are not "pure hyaline," but grayish with a distinct brownish tinge along costa and the outer half. The legs of *C. nigripes* are described as "pitchy black, the tibiæ and tarsi fulvous pubescent," while in this specimen the femora only are "pitchy black," the tibiæ and tarsi yellow, all

the joints of the latter annulated with black, with an apical band of black on the tibiæ. In the closely allied species *C. cruciatus* Say, the color of the legs is extremely variable. There seems therefore to be little doubt but that this represents only an extreme variation of *C. nigripes* although the species has not been recorded north of the Black Mountains, N. C.

Phthiria borealis n. sp.

Black, covered with a dense yellowish gray pollen; the frontal orbits, occiput, humeri, scutellum and a narrow posterior margin on the abdominal segments, dull yellow; antennæ and proboscis black, the latter slightly more than double the length of the head, legs black, tips of the coxæ and femora yellow; halteres light yellow with a brown spot on the side of the knob. Wings pure hyaline. Length 3.5 mm.

Type ♀, Fort Kent, Maine, August 7, 1910. Two specimens were also collected by Dr. J. A. Cushman at Little Black River Rapids, Maine, September 13, 1907. This is the most northern representative of the genus thus far discovered in North America.

Phthiria sulphurea Loew.

A specimen of this species from Horse Neck Beach, Mass., collected August 9, by Dr. G. de N. Hough is in the collection of the American Museum of Natural History.

Phthiria coquilletti Johnson.

Two specimens were collected by Dr. J. A. Cushman on Nantucket, Mass., July 4, 1906. They are slightly smaller than the types from southern New Jersey.

Phthiria cyanoceps Johnson.

In addition to the type locality (Cohasset, Mass.) this species has been taken at Barbour's Heights, R. I., September 19, 1908, by Prof. John Barlow.

Chalcomyia aerea Loew.

This interesting species was taken at Auburndale, Mass., May 8, 1905. I have also collected it near Clifton, Delaware County, Pa., May 5, 1895, on an old log in the bright sunlight.

Brachyopa vacua Osten Sacken

Cohasset, Mass., June 5, 1904 (Owen Bryant). It has also been taken at North Saugus, Mass.

Brachyopa media Williston.

A specimen was captured on the summit of Mt. Greylock, Mass., June 15, 1906; on the flowers of the wild cherry. Mr. E. J. Smith also collected a specimen at Sherborn, Mass. A peculiar variation of this species, in which the abdomen is entirely black, was obtained by Mr. E. Daecke at Castle Rock, Delaware County, Pa., May 19, 1901.

Sphegina campanulata Robertson.

This species seems to be quite generally distributed throughout New England:—Branford, Conn., May 25, 1905 (Rev. H. W. Winkly); Hampton, N. H., June 25, 1908 (S. A. Shaw); Machias, Maine, July 17–22, 1909 (C. W. Johnson).

Xanthogramma tenuis Osburn.

A single example of this western species was obtained by the writer at Ethan Allen Park, Burlington, Vt., June 24, 1906.

Eumerus strigatus Fallen

Pipiza strigata Fall., Dipt. Seuc. Syrphici, 61, 8, 1817.
Eumerus grandicornis and *funeralis* Meigen, Syst. Beschr., III, 208, 1822.
E. lunulatus and *planifrons* Meigen, Syst. Beschr., III, 209, 1822.
E. æneus Macq., Soc. Sci. Lille, 1827, p. 269, Hist. Nat. Ins. Dipt I, p 528, 1834.

Two specimens of this European species have come under the writer's observation. The first was obtained at Brookline, Mass., June 1909; the second was received from Mr. M. C. Van Duzee who collected it at Buffalo, N. Y., June 3, 1908. The genus has not been recorded from America, but the presence of this species in such widely separated localities seems to preclude the possibility of recent introduction. The above synonomy is that given (in part) in the Katalog der Paläarktischen Dipteren, III, 137.

Xylota (?) tuberans Williston.

This interesting species has been collected at a number of places during the past few years: Squam Lake, N. H., June 22, 1907 (Dr. G. M. Allen); Mt. Equinox, Manchester, Vt., June 5, 1910.

Hypoderma bovis De Geer.

The ox-bot seems to have been unusually prevalent the past season. Mr. Wm. Merrill of West Newbury, Mass., in a letter dated May 17, 1910, says: "I have never seen the ox-bot so numerous; of our eight head of cows every one is affected with from six to over sixty each. Other cows in the neighborhood are also affected." I visited West Newbury, May 27, and saw the cows referred to but obtained only one larva; most of the larvæ having already left the cattle. The larva was apparently full grown, but light brown in color.

During the early part of June while at Manchester, Vt., I found the cattle slightly affected, about half of the cows having from one to four bots. Three larvæ were obtained June 9, one of which was white, about half grown, I should judge, but the swelling was just as large due to the presence of a large amount of pus; the second specimen was a light brown apparently full grown, but like the one from West Newbury failed to pupate; the third was evidently ready to leave the cow, the opening was large and the larva blackish in color. It was placed in damp earth and pupated June 11, the imago emerging June 30. From these observations I am inclined to doubt the statement that "the full-grown larva when escaping from the back is of a grayish-white color."

In comparing the above-mentioned fly with specimens of *H. lineatum* De Villiers, from Texas and Colorado, I find that the species is *H. bovis*, the occurrence of which in North America has been doubted. Whether all of the larvæ referred to belong to this species I cannot say, as both species probably occur in New England. *H. bovis* can be readily distinguished from *H. lineatum* by yellow pile of the thorax extending to the suture, the broader and less conspicuous polished ridges on the thorax, the wings slightly darker, the entirely black metanotum and black tibiæ. It is also noticeably larger and more robust.

Ceratinostoma ostiorum Haliday.

Scatophaga ostiorum Halid., Curtis Brit. Entom., 405, 1832.
Scatomyza boreale Zett., Ins. Lapp., 721, 4, 1838.
Scatophaga oceana Macq., Ann. Soc. Ent. France, VII, 423, pl. 11, fig. 2, 1838.
Lispa lestremense Bigot, Anna. Soc. Ent. France, IV, (Ser. 6) 292, 1884.
Ceratinostoma maritimum Meade, Ent. Monthly Mag., XXII, 152, 1885.

This European species has not been recorded from North America although it is quite generally distributed along the New England coast. I first received several specimens from Mr. S. A. Shaw, collected at Hampton Beach, N. H., May 24. Mr. Owen Bryant captured a specimen at Cohasset, Mass., September 9, and Dr. C. S. Minot a specimen at Northeast Harbor, Maine, July 4, 1909. On July 25, 1907, the writer obtained a number of specimens at Orr's Island, Maine, on the wet rocks at low tide. A number were also obtained on the rocky shore at Shackford's Head near Eastport, Maine, July 14, 1909.

Mead refers to this genus as occupying an intermediate position between Scatophaga and Cordylura. "It has the elongated horny proboscis with the numerous vibrissæ of the species in the former genus and the sub-cylindrical incurved clubbed male abdomen of those of the latter."

The species can be readily recognized by the following characters: Face white, front dark brown, antennæ and proboscis black, palpi yellow. Thorax, abdomen and legs slate-gray in color, the former having three wide obscure stripes. Tegulæ and halteres yellow. Hairs and bristles noticeably shorter than in most of the *Scatophagi*. Length 8 mm. The synonomy is that given in the Katalog der Palãarktischen Dipteren, IV, 12.

Scatophaga volucricaput Walker.

Cordylura volucricaput Walker, List Dipt. Brit. Mus. pt. 4, p. 977, 1849; Aldrich, Cat. N. A. Dipt., p. 566.
Hydromyza volucricaput Slosson, Ent. News, Vol. VI, p. 320, 1895.

Specimens agreeing with the description of this species (which proves to be a Scatophaga) are represented from the following localities: Mt. Washington, N. H., (Mrs. Slosson); Durham, N. H., July 17, 1905 (J. Randall); Buffalo, N. Y., October 25 (M. C. Van Duzee).

Palloptera similis n. sp.

Head and antennæ yellow, arista brown, ocellar triangle blackish. Thorax and scutellum shining, reddish yellow, pluræ yellow, opaque. Abdomen shining, yellow, the posterior edges of the segments narrowly and the sides broadly margined with black. Legs and halteres light yellow. Wings with the broad anterior of dark brown, as in *P. superba* Loew, but the brown at the posterior cross vein is not connected. Length, 6 mm.

One ♀ collected by the writer at Fort Kent, Maine, August 17, 1910. Type in the New England Collection of the Boston Society of Natural History.

This species closely resembles *P. superba* but is readily separated by its shining thorax and abdomen, with the black margins of the segments continuous and not punctate. From *P. jucunda* it is distinguished by its larger size and by the marginal cell being entirely brown.

Palloptera arcuata Fallen.

Two specimens of this species were collected by Dr. C. S. Minot at Northeast Harbor, Maine, July 1, 1909. It has previously been recorded in America only from the White Mts., N. H. *Sapromyza inusta* Meigen given as a synonym in Aldrich's Catalogue (p. 582) is a good species and a true Sapromyza. Figure 15, page 80 of Williston's Manual North American Diptera, represents *Palloptera superba* and not *P. jucunda* Loew.

ORTALIDAE.

The following species of this family have been collected in various parts of New England, extending considerably their recorded distribution.

Rivellia brevifasciata Johns., Tuckernuck Isl., Mass., July 21, 1910 (Dr. G. M. Allen).

Rivellia conjuncta Loew, New Haven, Conn., June 8 (Dr. W. E. Britton); Barnstable, Mass., July 4; Woods Hole, Mass., July 24 (C. W. Johnson).

Rivellia quadrifasciata Macq., New Haven, Conn., Aug. 1, Springfield, Mass., July 13 (Dr. Dimmock).

Rivellia pallida Loew, Mt. Greylock, Aug. 8, 1907 (Owen Bryant); Auburndale, Aug. 9, and Plymouth, Mass., July 27 (C. W. Johnson).

Tritoxa incurva Loew, East Hartford, Conn., Aug. 9, 1904 (P. L. Butrick).

Tephronota canadensis Johns., Eastport, Maine (C. W. Johnson).

Tetanops luridipennis Loew, New Haven, Conn., June 26 (H. L. Viereck).

Euxesta scoriacea Loew, Bourne, Mass., June 17 (P. G Bolster).

Chaetopsis apicalis Johns., Common along the salt marshes at Edgartown, Chatham, and Cohasset, Mass.

Seoptera colon Loew, Northeast Harbor, Maine, July 16, 1906 (Dr. C. S. Minot).

Stenomyia tenuis Loew, North Haven, Conn., Nantucket, Barnstable and Woburn, Mass. This is now placed in the genus *Chætopsis* by Hendel (Gen. Ins., Muscaridæ, Ulidinæ, p. 35).

Eumetopia rufipes Macq., New Haven, Conn., July 27, 1904 (P. G. Butrick); Kingston, R. I., June 23, 1905 (Barlow); Now placed in the genus *Eumetopiella* Hendel 1907.

Tanypeza longimana Fallen.

This species, although not recorded from North America, seems to be quite generally distributed: Algonquin, Ill., June 8, 1895 (Dr. W. A. Nason); Niagara Falls, N. Y., June 28, 1901; Norwich, Vt., July 8, 1908.

Saltella scutellaris Fallen.

Piophila scutellaris Fall., Heteromyzides, 10, 3, 1820.
Nemopoda ferruginea Desv., Myodaires, 744, 2, 1830.
Saltella nigripes Desv., Myodaires, 747,2, 1830.
Nemopoda scutellata and *ruficoxa* Macq. Hist. Nat. Dipt., II, 481, 1835.
Saltella pectoralis Zett., Dipt. Scand., IV, 2515, 8, 1847.

A single specimen of this European species was taken by Mr. M. C. Van Duzee at Hamburg, N. Y., June 20, 1909.

Eusiphona mira Coquillett.

Hanover, N. H., July 14–6, 1908. It was found only on the flowers of the cone-flower (*Rudbeckia hirta*).

Odinia maculata Meigen.

Milichia maculata Meig., Syst. Beschr., VI, 132, 1830.
Milochia ornata Zett., Ins. Lapp., 787, 1, 1838.
Odinia trinotata Desv., Myodaires, 648, 1, 1830.

Dauphine County, Pa., April 20, 1897 (Dr. D. M. Castle); Cambridge, Mass., June 11, 1908 (Dr. G. M. Allen).

Odinia picta Loew.

There seems to be no record of the occurrence of this species since it was described from Georgia. A specimen was taken by the writer at Glenside, Pa., June 2, 1895. A second specimen from Branford, Conn., June 23, was collected by Mr. H. L. Viereck.

THE NORTH AMERICAN FORMS OF *LASIUS UMBRATUS* NYLANDER.[1]

By William Morton Wheeler.

Like many other ants that are peculiar to the north temperate zone, *Lasius umbratus* is very widely distributed and presents a number of local subspecies and varieties. In the Old World it ranges from England to Japan, through northern and central Eurasia; in North America from Nova Scotia and the Atlantic States to the Rocky Mountains and will probably be found on the Pacific Coast, at least in the mountains of California or at lower elevations in Washington and Oregon. According to Forel and Emery the species is represented in Europe by four subspecies, namely, the typical *umbratus* Nyl., *mixtus* Nyl., *affinis* Schenk and *bicornis* Förster. To these Ruzsky has added a fifth, *exacutus*, from Oriental Russia. To judge from a female specimen in my collection, the Japanese form is indistinguishable from the typical *umbratus*. Transitional forms which Forel has called *mixto-umbratus* occur in Switzerland, and others which Ruzsky has called *umbrato-affinis* have been taken in eastern Russia. Mayr cited three forms from the United States: *mixtus*, *affinis* and *bicornis*, but Emery has shown that the first of these differs slightly from the European *mixtus* and had been previously described by Walsh as *Formica aphidicola*, and that the last is a distinct subspecies which he has called *minutus*. He was unable to find *affinis* among his American material and I have been equally unsuccessful. This form, therefore, is probably not represented on our continent. More recently

[1]Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 30.

Viereck has described from New Mexico a new subspecies as *subumbratus*, and another subspecies, *vestitus*, from Idaho, is added in the present paper. This form may prove to be the hitherto unknown female of Emery's *L. speculiventris*, which, I believe, is merely a subspecies of *umbratus*.

All the various forms that constitute the species *umbratus* may be readily distinguished in the worker and female phases from the other species of *Lasius*, by the following peculiarities: the maxillary palpi are 6-jointed and this character places the species in the genus *Lasius sensu stricto* and removes it from the exclusively North American subgenus *Acanthomyops*, which includes species with 3-jointed maxillary palpi and a strong odor like that of lemon verbena or oil of citronella. The joints of the maxillary palpi in *umbratus* are not long and subequal as in *L. niger* and its various forms, but grow successively shorter towards the tip. It differs from our two other *Lasii* with yellow workers and diminishing maxillary joints (*L. flavus nearcticus* Wheeler and *L. brevicornis* Emery) in having the antennal scapes extending a considerable distance beyond the posterior corners of the head, the larger size of the eyes in the worker, and in being more or less tinged with brown in this phase. Moreover, the female *umbratus* has the head as broad as the thorax, whereas in *nearcticus* and *brevicornis* it is distinctly narrower. It is by no means easy to separate the various subspecies or races of *umbratus* on morphological characters, such as the size of the eyes of the worker, shape of the petiole of the worker and female, dentition of the mandibles of the male, etc., since these characters are rather inconstant. More satisfactory distinctions are furnished by peculiarities of stature, pubescence, pilosity and color.

Notwithstanding its wide distribution *L. umbratus* is by no means as common as other species of the genus. In North America however, it is much more frequently met with than in Eurasia; but even in our country it is sporadic, being abundant in certain localities and totally lacking in others. It prefers rather damp, shady spots like those occupied by *L. nearcticus* and the species of *Acanthomyops*. Like the species of this sub-genus it forms populous colonies under stones, in rotten stumps or logs or constructs large masonry dome nests. These dome nests I have seen only in meadows or in clearings in the woods where the soil is covered

with grass and is more or less exposed to the sun. The subspecies *subumbratus* is an exclusively boreal form, occurring only in British America and at elevations above 7,500 ft. in the Rocky Mountains. The same is probably true of *vestitus*. The subspecies *minutus* and *speculiventris* and the variety *aphidicola* occur in the transition zone and of these only *aphidicola* is at all common. Like our other yellow *Lasii*, *umbratus* is subterranean in its habits and devotes itself to the care of root-aphids and -coccids, all or nearly all of its food consisting of the sweet excreta of these insects.

The sexual phases are rarely found in the nests of *umbratus*, apparently because they are not retained by the parental colonies for days or weeks during the latter part of the summer or early fall but escape for their marriage flight very soon after reaching maturity. Recent studies in Europe indicate that the just-fertilized *umbratus* queen is unable to establish her colony independently after the manner of *L. niger* and *flavus*, but becomes a temporary parasite on a colony of *niger* or of one of its subspecies or varieties after the manner of certain species of *Formica* of the *rufa* and *exsecta* groups. Our American *umbratus* forms apparently behave in the same manner. De Lannoy and Wasmann, moreover, have collected some evidence to show that *umbratus* is in turn the temporary host of the palearctic *L. fuliginosus*. The rare or sporadic occurrence of *umbratus* on both continents certainly points to parasitic habits on the part of the queen and her incipient colony.

The following tables will facilitate the identification of workers and females of our North American forms of *umbratus:*

WORKERS.

1. Antennal scapes and tibiæ with very few or no erect hairs; gaster with appressed pubescence. 2
   Antennal scapes and tibiæ with abundant erect hairs; gaster without pubescence.... ....subsp. **speculiventris** Emery.
2. Gaster with sparse pubescence and short erect hairs, shining; average length of body over 4 mm.... 3
   Gaster very densely pubescent, with long erect hairs, subopaque; average length of body less than 4 mm..... .....subsp. **minutus** Emery.
3. Pale yellow; eyes small..... .....subsp. **subumbratus** Viereck.
   Brownish yellow; eyes larger....subsp. **mixtus** Nyl. var. *aphidicola* Walsh.

FEMALES.

1. Length not exceeding 4.5 mm . . . .subsp. **minutus** Emery.
   Length not less than 6 mm 2
2. Scapes and legs covered with dense, erect hairs; length 6 mm..... subsp. **vestitus** subsp. nov.
   Scapes and legs naked or with only a few scattered erect hairs; average length more than 6 mm.....3
3. Body dark brown above; erect hairs on the gaster very short or absent.....subsp. *mixtus* Nyl. var. **aphidicola** Walsh.
   Body light brown or reddish; hairs on gaster very long, reclinate.....subsp. **subumbratus** Viereck.

1. Lasius umbratus subumbratus Viereck.

Trans. Ent. Soc. Phila. XXIX, 1902, p. 72. ♀.

Worker. Length 4–5.5 mm.

Very similar to the typical *umbratus*. Body shining and rather smooth, especially the clypeus and gaster. Pubescence and pilosity abundant, the former more so on the head and thorax than on the gaster. Erect hairs on the femora few and scattered, absent on the tibiæ and scapes. Eyes small. Petiole high and much compressed anteroposteriorly, its sides and upper border rounded, the latter entire or with a very feeble notch. Pale yellow throughout, except the mandibles, which are reddish brown, with black teeth, and the articulations of the antennal funiculi which are fuscous or blackish.

Female. Length 7–8.5 mm.

Differing from the true *umbratus* as follows: Color paler, being a light brown or reddish, with the lower surface and the legs more yellowish. Pubescence much longer and more abundant. Hairs on the head, thorax and abdomen very long, slender and reclinate; absent on the legs and scapes. In some specimens the hairs on the head are short and sparse. Border of the petiole bearing a fringe of long hairs, its upper border much less deeply notched than in the true *umbratus*. Wings gray, with basal halves distinctly infuscated as in the other forms of the species.

Male. Length 3.5–4.5 mm.

Differing from the true *umbratus* only in its somewhat paler color and in lacking erect hairs on the legs and scapes. Eyes hairy as in that form and with the mandibles furnished with two larger apical and several minute basal teeth.

This subspecies was originally and rather inadequately described by Viereck from two females taken at Beulah, N. M. (about 8,000 ft.), one August 17 by Dr. H. Skinner, and one July 27 by Prof. T. D. A. Cockerell. These are in the type collection of the Phila. Acad. Nat. Sci. In my own collection the form is represented from the following localities:

New Mexico: Beulah (Cockerell; topotype), one deälated female.

Colorado: Two females, one deälated, taken by P. J. Schmitt; one deälated female taken by myself in Cheyenne Cañon (about 8,000 ft.), near Colorado Springs; numerous workers from Williams Cañon, near Manitou (about 7,500 ft.), also captured by myself.

Utah: Numerous workers from Little Willow Cañon (C. V. Chamberlin).

Nova Scotia: Many workers, males and winged females taken from five colonies by Mr. John Russell at Digby, and six deälated females taken at Bedford, near Halifax by Mr. William Reiff.

Dr. P. P. Calvert and Mr. E. T. Cresson, Jr., kindly compared one of the female specimens from Nova Scotia with Viereck's type and state that the former differs from the latter only in being somewhat more yellowish and less reddish. I am unable to detect any differences even in coloration between my Rocky Mountain specimens and those from Nova Scotia.

It is interesting to note, as bearing on the probable temporary parasitism of *umbratus*, that the six deälated queens taken by Mr. Reiff at Bedford, N. S., were found living in three colonies of the large yellowish form of Lasius *niger* var. *neoniger* Emery so characteristic of boreal America.

2. Lasius umbratus mixtus Nyl. var. aphidicola Walsh.

Formica aphidicola Walsh, Proc. Ent. Soc. Phila. 1862, p. 310, worker ♂.
Lasius aphidicola Mayr, Verh. zool.-bot. Ges. Wien, XXXVI, 1886, p. 429; Dalla Torre, Catalog. Hymen. VII, 1893 p. 182.
Lasius umbratus subsp. *mixtus* var. *aphidicola* Emery, Zool. Jahrb. Abth. f. Syst. VII, 1893, p. 640, 641, worker ♀ ♂; Wheeler, Bull. Amer. Mus. Nat. Hist. XXI, 1905, p. 397; Occas. Papers Bost. Soc. Nat. Hist. VII, 7, 1906, p. 13.
Lasius speculiventris Wheeler, Bull. Amer. Mus. Nat. Hist. XXI, 1905, p. 397.

Worker. Length 3.5–4.5 mm.

Brownish yellow, with the appendages, lower portion of the body and anterior portion of the head paler. Surface, especially the dorsum of the gaster shining, owing to the short and dilute, though distinct pubescence. Hairs erect, coarse and rather abundant, short on the gaster, absent on the scapes and legs. Petiole seen from behind with rounded or subangular sides and the notch in the upper border variable, but usually feeble.

Female. Length 6–7 mm.

Dark brown; mandibles, appendages, pleurae, epinotum and petiole usually reddish or yellowish. Basal half of wings strongly infuscated. Pilosity and pubescence similar to those of the worker but the pubescence on the gaster denser so that this region is much less shining than in the worker. Erect hairs on the gaster often absent, when developed scattered and very short except on the terminal segments. Eyes very hairy. Petiole from behind with rounded sides and upper border, the latter feebly emarginate.

Male. Length 4–4.5 mm.

Mandibles with two apical and no basal teeth. Body black; appendages piceous; wings colored like those of the female. Surface, especially that of the gaster, smooth and shining. Pilosity moderately developed, erect; absent on the scapes and legs; pubescence more dilute and inconspicuous than in the worker. Eyes hairy.

I have followed Emery in regarding this subspecies as the one which Walsh described as *Formica aphidicola*, though his description is very inadequate. As it is our most common form of *umbratus*, it is, in all probability, the one which he saw. The types came from Rock Island, Ill. I have examined numerous specimens from the following localities:

Illinois: Rockford (Wheeler); Algonquin (W. A. Nason).

Wisconsin: Milwaukee (C. E. Brown).

Michigan: Ann Arbor (J. Dawson).

Maine: Elms (W. Deane).

New Hampshire: Mt. Washington (Mrs. A. T. Slosson).

Massachusetts: Boston (Wheeler); Essex County (G. B. King); Medford (Mus. Comp. Zool.).

Connecticut: Colebrook (Wheeler); Westport (W. E. Britton).

New York: Bronxville (Wheeler); Bergen Beach (G. v. Krockow); Staten Island (W. T. Davis).

New Jersey: Ithaca (J. C. Bradley); Fort Lee, Great Notch and Ramapo Mts. (Wheeler); Tom's River (W. T. Davis); Woodbury (H. Viereck).

Pennsylvania: St. Vincent (P. J. Schmitt), Philadelphia; Tinicum Islands; Enola.

North Carolina: Black Mts. (Wm. Beutenmuller); Raleigh (F. Sherman).

Colorado: Florissant and Colorado Springs (Wheeler); Eldora, 8,600 ft. (Mrs. W. P. Cockerell).

Emery cites *aphidicola* also from Caldwell, N. J., District of Columbia and Virginia. According to this authority, *aphidicola* is so close to the European *mixtus* as to be scarcely distinguishable. The color of the worker of the American form is usually darker, and the body and wing color of the female is decidedly deeper. Worker forms are sometimes found with a few, scattered erect hairs on the antennal scapes and tibiæ and therefore represent transitions to the typical *umbratus*.

3. Lasius umbratus minutus Emery.

Lasius umbratus var. *bicornis* Mayr, Verh. zool.-bot. Ges. Wien, XXXVI, 1886, p. 480.

Lasius umbratus subsp. *minutus* Emery, Zool. Jahrb. Abth. f. Syst. VII, 1893, p. 641, worker ♀ ♂; Wheeler, Bull. Amer. Mus. Nat. Hist. XXI, 1905, p. 397; Occas. Papers Bost. Soc. Nat. Hist. VII, 7, 1906, p. 13.

Worker. Length 3–3.5 mm.

Brown, with the cheeks, clypeus, mandibles, appendages and lower surface of the body more yellowish. Body so densely pubescent that its shining surface is obscured and appears glossy or subopaque. Hairs on the head, thorax and gaster abundant, erect and coarse, on the gaster longer and more conspicuous than in the two preceding subspecies. Scapes and legs naked; lower surfaces of the femora with a few scattered, erect hairs. Petiole high and narrow, with straight sides and a distinct notch in the apical border.

Female. Length 4–4.5 mm.

Dark brown; mandibles, mouthparts and appendages, except the middle portions of the femora, pale brown; wings gray with infuscated bases. Pubescence and pilosity very similar to those of the worker, but longer. Petiole more feebly notched.

Male. Length 2.6–3.5 mm.

Black; with piceous legs and antennæ. Wings colored like those of the female. Mandibles with two apical and no basal teeth. Pubescence and pilosity like those of the worker, but the former more dilute, so that the surface of the body is more shining. Discoidal cell of the wing often incomplete or lacking.

The type specimens described by Emery came from New Jersey and Maine. I have examined specimens from the following states:

New Jersey: Cotypes (T. Pergande).

Maryland: Chestertown (E. G. Vanatta).

Illinois: Rockford (Wheeler).

Michigan: Ann Arbor (J. Dawson).
Connecticut: Colebrook (Wheeler).
Massachusetts: Forest Hills, Boston (M. Tanquary); Medford (Dall.).

Emery has called attention to the resemblance of this species, which is characterized by the small size of the females and the peculiar pubescence and pilosity of these and the workers, to the European *bicornis* and *affinis*. The description given above is drawn from numerous specimens of all three phases taken August 12, 1910, taken by Mr. M. Tanquary from a large masonry dome nest in low ground near Forest Hills, Mass. The deälated females bear a remarkable resemblance in size and coloration to the corresponding phase of our common *Tapinoma sessile*.

4. Lasius umbratus vestitus subsp. nov.

Female. Length about 6 mm.

Differing from *subumbratus* and *aphidicola* in its smaller size and in pilosity. Body dark brown above, with paler lower surface, mandibles, antennæ and legs. Surface finely shagreened and shining but appearing more opaque on account of the dense layer of fine grayish pubescence. Hairs sordid white, fine and uniformly abundant, erect, long on the body, shorter on the scapes and legs. The petiole, which is fringed with long hairs, has a peculiar shape, being in profile cuneate and inclined forward and rather thick at the base; seen from behind it is narrowed above, with a blunter and more rounded margin than in the other subspecies, and without emargination. Wings very long (8 mm.), faintly infuscated at the base.

Described from a single specimen taken by Prof. J. M. Aldrich at Moscow, Idaho.

This may be the female of *L. speculiventris*, of which Emery described only the male and worker.

5. Lasius umbratus speculiventris Emery.

L. speculiventris Emery, Zool. Jahrb. Abth. f. Syst. VII, 1893, worker ♂.

" *Worker.* Yellow; head subpubescent, densely hairy; scapes and tibiæ hirsute with erect hairs; head, thorax and legs pubescent, gaster without appressed pubescence, delicately, microscopically, transversely rugulose, very shining. Length 3.5–4 mm.

Male. Fuscous; legs, antennæ and genitalia pale; densely pilose; scapes with short hairs; tibiæ with scattered, scapes with short hairs; wings clouded with fuscous at the base. Length 3.5–4 mm., width of head 1.2 mm., length of scape 0.7 mm., anterior wing 4.5 mm.

Caldwell, N. J., from Mr. Pergande.

The worker is distinguished by the abundant, erect pilosity of the antennal scapes and tibiæ and by the complete absence of appressed pubescence on the gaster. The latter region, owing to the lack of the fine punctures connected with the pubescence, is remarkably shining. With the aid of a very strong lens its surface is seen to present, in addition to the hair-bearing punctures, only a very fine rugosity, in the form of long, transverse meshes. Whether this form is to be retained as an independent species or is to be regarded as a subspecies of *umbratus*, cannot be decided at present.

In the male the antennal scape is densely covered with short, oblique hairs as on the male of the European *umbratus;* it is relatively short and when placed transversely reaches beyond the eye about two fifths of the length (in *umbratus* the transversely placed scape extends easily half its length beyond the eye). The tibiæ bear only a few erect hairs. The general pilosity is more abundant and like that of the males of the true *umbratus* which I have before me." (Emery.)

I have translated the original description because I have not seen specimens of *speculiventris*. In my "Annotated List of the Ants of New Jersey" I stated that I had taken this form at Fort Lee and Great Notch, but examination of these specimens shows that they are merely very shining examples of *aphidicola*. As the characters mentioned in Emery's description are scarcely of specific value, I believe that I am justified in placing *speculiventris* among the *umbratus* forms. As already stated the subspecies described above as *vestitus* may be merely the hitherto unknown female of Emery's form.

SOME BEES FROM ELDORA, COLORADO.

By T. D. A. Cockerell.

The University of Colorado, Boulder, Colo.

My wife and I spent the afternoon of August 18 and morning of August 19, 1910, at Eldora, in the mountains of Boulder County, Colorado. The locality is in the Canadian Zone, at an altitude of about 8,550 ft., and has a bee-fauna rather widely different from that of Boulder. So many interesting species were collected that it seems worth while to put the whole on record. At this season of the year, the best bee-plant at Eldora is *Grindelia subalpina* Greene, a very fine species which makes the valleys gay with its orange-yellow flowers. Less abundant, and much less conspicuous is *Phacelia leucophylla* Torrey, with white flowers. These two are referred to by their generic names alone in the following list:

Andrena n. sp. Much like *A. hirticincta*, but hair at end of female abdomen pale. Females rather common at *Grindelia;* one male on *Erigeron*. This species was named in MS. by Viereck, from specimens collected in New Mexico; it will be published in his revision.

Halictus lerouxii Lep. Both sexes common at *Grindelia*.

Halictus ruidosensis Ckll. Both sexes at *Phacelia*, the males abundant.

Agapostemon texanus subtilior Ckll. One male at *Grindelia*. This sex is undescribed; it differs from true *texanus* by its smaller size, the metathorax more delicately sculptured, black on legs reduced, and flagellum paler.

Specodes (*Sphecodium*) **fragariæ** Ckll., var. a. Female smaller, about 5 mm. long, face more narrowed below, middle of abdomen much suffused with black. One at *Phacelia*. This may be a distinct species, but I have only a single specimen, and *fragariæ*, as represented by numerous specimens collected at Florissant, is very variable.

Perdita snowii Ckll. Common at *Grindelia*. This species was described from a single specimen collected by Snow in 1892 in Estes Park, Colorado. Later, I took a specimen at Santa Fé, New Mexico, but the species has escaped rediscovery in Colorado until the present time. The male, which was not known, runs in my table in Proc. Phila. Acad. Sci., 1896, to 28, except that there is a small black mark or band along each side of the upper part of the clypeus, not on the clypeus itself. It runs on to 30, but face is bare, while mesothorax is hairy. The following characters are distinctive: Face below antennæ bright chrome yellow; yellow in median line extending above antennæ as a small spear-head shaped mark; at sides

extending upwards broadly, then abruptly ending, except for a line along the eye, the whole like a closed hand with index finger pointed; a narrow yellow stripe along lower half of posterior orbits; scape yellow; flagellum yellow beneath; anterior knees yellow and their tibiæ broadly yellow in front; tubercles and two marks on upper border of prothorax yellow; middle legs with much yellow, but hind legs with only knees yellow; abdominal bands yellow, broad, entire, except the first, which is narrowly interrupted. A marked character of the species is the dull hairy mesothorax.

Panurginus didirupa Ckll. Both sexes taken; the females at *Grindelia*.

Panurginus bakeri Ckll. Both sexes at *Phacelia*. The female is new; it is about 5½ mm. long, with the legs black, including tarsi; face all black, shining; wings smoky; nervures and stigma dark. It resembles the female of *P. pauper*, but is easily separated by the dark tegulæ and more distinctly punctured mesothorax.

Nomada accepta Cress. One female at *Grindelia*.

Triepeolus subalpinus n. sp. One at *Grindelia*.

♀. Length about 11½ mm.; a species with "false pygidium" relatively small, related to *T. micropygius* Rob., but anterior legs black, with tarsi reddish; middle femora black above, red beneath; hind femora and middle and hind tibiæ and tarsi red; spurs black; upper part of pleura covered with dull pale yellowish hair, thin in middle posteriorly, lower half bare, coarsely and closely punctured, but some of the shining surface visible on the lower part; labrum black, densely punctured; mandibles black, faintly reddish toward apex; clypeus closely, very minutely punctured, with scattered large punctures; antennæ black, third joint reddish apically; mesothorax very densely punctured, with a light hair-margin at sides and behind, and a pair of short and broad, not dense, anterior longitudinal bands; teeth at sides of scutellum hardly produced; tubercles black; tegulæ reddish-brown, closely punctured; second submarginal cell narrowed almost to a point above; black area of first abdominal segment a broad transverse band, truncate laterally; apical and basal light bands of first segment narrowly interrupted, the others entire, fifth with a large, light patch on each side; band on second segment with anterior lateral extensions broadly triangular, the angle formed very obtuse. Superficially like *T. pectoralis* Rob., but easily separated by the reduced axillar teeth, form of band on second abdominal segment, much denser punctures on lower part of pleura, etc.

Epeolus eldoradensis n. sp. Two at *Grindelia*.

♂. Length about 8 to 9 mm.; very close to *E. argyreus* Ckll., but wings brownish, middle and hind legs more or less red, and third antennal joint without red. The metathoracic area is larger than in *argyreus*, the cheeks are broader, and the femora are not so hairy.

Eyes sage green; hair of face pure shining white; clypeus densely minutely punctured, without large punctures; antennæ black; mesothorax with rather thin pale creamy hair, rather evenly distributed, so that there are no definite markings; axillar teeth very short and blunt; tubercles black; tegulæ dark reddish-brown;

second s. m. narrow, narrowed about one-half above; pleura very densely covered with shining white hair; middle and hind spurs black; anterior legs black; middle red, the femora black above; hind legs red; abdominal segments 1 to 6 covered with pale ochreous-tinted hair, no definite light patch on first, but a small discal area where the hair is thinner, and there are a few reddish scales; second segment with a broad basal band of reddish hair, not reaching the sides, third with a narrower band of the same kind.

Var. a. Smaller; Midde femora black, as also outer side of their tibiæ; hind femora black except at apex, and their tibiæ suffused with blackish on outer side; first abdominal segment with a transverse, rather poorly defined black (bare) band; second with the basal half black except at sides. This looks distinct, but is probably only a variety, as *Argyroselenis minima* Rob. varies in much the same manner as to the abdomen. It is the var. a. which most resembles *E. argyreus*.

Clisodon terminalis Cress. One female at *Chamœnerion angustifolium*.

Melissodes hymenoxidis Ckll. Females at *Grindelia*, also nesting in ground. Two were observed to enter the same nest.

M. confusa Cress. Both sexes at *Grindelia*.

M. confusiformis Ckll. One female at *Grindelia*.

M. menuacha Cress. One male at *Grindelia*. This is the same as the New Mexico insect I have identified as *menuacha*, but differs from a Colorado example (not the type) from the Cresson collection. I believe it is the real *menuacha*, and that Cresson confused two or more species in his collection.

Coelioxys porterae Ckll. One female on sand.

Megachile wootoni calogaster Ckll. One female at *Campanula petiolata*.

Megachile pugnata Say. Females at *Grindelia*.

Megachile perihirta Ckll. One male at *Grindelia*.

Megachile relativa Cress. Females at *Grindelia*.

Alcidamea simplex Cress. Females at *Phacelia*.

Osmia copelandica Ckll. Female at *Phacelia*. The second known specimen.

Osmia pentstemonis Ckll. One female at *Grindelia*.

Osmia wardiana Ckll. One female at *Grindelia*. This is narrower than usual, but apparently not a distinct species.

Osmia fulgida Cress. Two females at *Phacelia*. These are green, and agree with the form named *viridis* by Cresson, except that the hair of the thorax above, instead of being black, is reddish with a few black hairs intermixed.

Osmia densa Cress. Two females, one at *Grindelia*. A variable species.

Osmia grindeliæ n. sp. One at *Grindelia*. Var. a. at *Phacelia*.

♀. Length about 9 mm.; the abdomen subglobose; head about as wide as thorax, dark greenish and purplish, densely punctured; clypeus mainly dark purplish; cheeks olive green; face, front and vertex with long coarse black hair, occiput with some white hair; mandibles tridentate; flagellum faintly reddish beneath except at base; mesothorax black on disc, green at sides; scutellum and postscutellum olive-green, but metathorax dark bluish; hair of thorax above white, with long black hairs sparsely intermixed; of pleura black, comparatively short, of sides of metathorax white; tegulæ piceous; wings stained with brown; legs black, not metallic; abdomen dark green, the hind margins of the segments

bluer; first segment with white hair, the others with it thin, short and black, a little glittering white principally along hind margins of segments and on apical segment; scopa black.

In my table in Univ. of Colo. Studies, 1907, p. 250, this runs to *O. wilmattæ*, from which it differs by its darker, green, coloration, and the smaller subglobose abdomen. The hair on the pleura is only about half as long as in *O. pikei*.

Var. a. Similar, but hair of pleura somewhat pallid. This is much darker than *O. phaceliæ*, and the tegulæ are not conspicuously green in front as in that species.

Anthidium tenuifloræ Ckll. Both sexes at *Grindelia*.

Dianthidium pudicum Cress. Both sexes at *Grindelia*.

Apis mellifera ligustica Spin. Only one seen; at *Grindelia*.

Bombus flavifrons Cress. At *Grindelia*.

Bombus juxtus Cress. At *Phacelia*.

Bombus rufocinctus astragali Ckll. One male at *Grindelia*.

For other records of Bombidæ from Eldora, see Univ. of Colo. Studies, IV, pp. 257–258, and VII, p. 186.

SOME BEES FROM ECUADOR.

I am indebted to Mrs. L. H. Dyke for some bees which she recently collected at Portobelo (pronounced Porto Bello), Ecuador, at an altitude of about 4,000 ft.

(1) **Euglossa cordata** (L.)

(2) **Xylocopa varians ecuadorica** Ckll. This was described only last year, from material in the British Museum.

(3) **Mesocheira bicolor elizabethae** subsp. nov.

♀. Length 12 mm., in most respects similar to *M. bicolor*. Face, cheeks, and occiput with dull white (not reddish) hair, vertex with black; antennæ black, the first three joints and extreme base of fourth broadly red beneath; thorax above dark green, the scanty hair dull white and black; abdomen a fine greenish blue, almost steel-color, but greener, the basal part of the first segment dark red. Extraordinarily like *Melissa decorata* Smith, but the scutellum quite different. Named after Mrs. Dyke's little daughter Elizabeth.

These bees illustrate the fact, already indicated by other collections, that the Brazilian bee-fauna passes over into the mountains of Ecuador, the species becoming in most cases distinctly modified.

T. D. A. Cockerell.

A FEW NEW PSAMMOCHARIDÆ.

By Nathan Banks.

East Falls Church, Va.

Psammochares transversalis n. sp.

♀. Black; face silvery each side of the antennæ, wings black. Clypeus truncate, margined; antennæ long, slender, third joint very long, as long as width of the face at antennæ; a very distinct line from antennæ to anterior ocellus, latter a little more than its diameter from the smaller laterals, these as close to the eyes as to each other; vertex, from in front, barely rounded; face rather narrow, narrowed above; eyes large. Pronotum depressed behind, and almost angulate; metanotum moderately long, with a median line on the basal part, and the apical part plainly transversely wrinkled; abdomen broad at base, dull, last segment rather brownish, fringed; legs slender, tarsi I with long cilia, more than twice as long as the width of a joint, hind legs not very heavily spinose, hind tibia with the longer spur nearly one-half as long as the metatarsus, last joint of hind tarsus with spines beneath, claws toothed. Wings of moderate length; marginal cell long, acute, second submarginal cell about twice as long as broad, first recurrent vein near the tip; third submarginal shorter, nearly one half narrowed above, second recurrent vein arising much beyond the middle of the outer cell, and running nearly straight to the middle of the third submarginal; basal veins interstitial in the fore-wings, widely dislocate in the hind-wings.

Length 13 mm.

From Palmerlee, Arizona (Biederman). Readily known by wrinkled metanotum.

Psammochares castella n. sp.

♂. Small, narrow, black, not silvery, except on the lower part of the face, second abdominal segment mostly dull red above. Head and thorax very sparsely hairy; clypeus truncate in front, not margined; face broad, especially above; antennæ heavy; a faint line from antennæ to anterior ocellus, latter scarcely more than its diameter from the laterals, and these as close to eyes as to each other; vertex from in front very distinctly rounded; pronotum angulate behind; metanotum short, suddenly depressed behind; abdomen broad at base, dull, apical segment with a marginal fringe; legs slender, only slightly spinose, hind tibia with only three spines above, more on sides, longer spur of hind tibia more than one-half as long as the metatarsus, last tarsal joint without spines below. Wings long and narrow, black, not darker at tips; marginal cells large, submarginals small, second larger than third, latter triangular; first recurrent near tip of second submarginal,

second recurrent arises a trifle beyond middle of outer cell and runs into third submarginal joint just beyond middle.

Length 6 mm.

From Fedor, Lee County, Texas, May.

Psammochares tenuicornis n. sp.

♂. Black, very sparsely hairy. Clypeus truncate; antennæ very slender, the third joint plainly longer than the fourth; a distinct line from antennæ to anterior ocellus, latter fully its diameter from the equal laterals, and these nearer to each other than to the eyes; vertex slightly rounded; face rather broad; pronotum strongly arcuate behind, almost argulate; metanotum with distinct median line, not hairy; abdomen rather narrow at base, no tufts of hair below near tip; legs slender, tibiæ with many short, small spines, longer spur of hind tibia barely one-half the length of the metatarsus; spines under last joint of hind tarsus; claws toothed. Wings slender, marginal cell long, nearly rounded at tip; second submarginal cell one and a half times longer than broad, receiving the first recurrent beyond middle, third submarginal about as long as second, but little narrowed above, second recurrent arising beyond middle of outer cell and curving outward to the third submarginal; basal veins dislocated in fore wings, interstitial in hind wings.

Length 11 mm.

From Southern Pines, North Carolina, May.

The forms allied to *Ps. philadelphicus* and *Ps. æthiops* may be tabulated as follows:

Pronotum angulate behind

Clypeus emarginate; hind wings with the basal veins disjointed **philadelphicus.**

Clypeus truncate; basal veins interstitial in hind wings..... **.illinoiensis.**

Pronotum arcuate behind

Clypeus deeply emarginate, head very hairy.....**aethiops.**

Clypeus barely emarginate, less hairy .....**.ilione.**

Psammochares ilione n. sp.

Black; hairy, but vertex not as hairy as in *Ps. æthiops;* clypeus barely emarginate in front, third joint of antennæ not near as long as the vertex width; the line from antennæ to the anterior ocellus obliterated in the middle; the anterior ocellus its diameter from the smaller laterals, these as close to each other as to eyes; vertex faintly rounded; face rather broad (broader than in *Ps. philadelphicus*); pronotum hairy, arcuate; metanotum short, the line indistinct; abdomen broad at base, rather dull black, apical segment with long black hairs; anterior tarsi with long cilia; hind tibiæ with the longer spur one-half of the metatarsus, spines below on last joint of hind tarsi. Wings rather long, marginal cell long, acute, second submarginal trapezoidal, first recurrent vein near tip; third submarginal almost

triangular, second recurrent arises a little beyond middle of outer cell and curves slightly outward to the middle of third submarginal; basal veins nearly interstitial in the hind wings.

Length 13–15 mm.

From Falls Church, Va.; Southern Pines, N. C.; and Sea Cliff, N. Y. This may be what has been called *æthiops* in the East, but very distinct from the *æthiops* of Colorado, which, however, I have also from Ithaca, N. Y.

Psammochares (*Allocyphonyx*) harpalyce n. sp.

Color and general appearance as in *Ps. maura;* but the male is distinct therefrom by prominent silvery hairs on the posterior slope of the metanotum, and the extreme tip of abdomen is pale; the antennæ are the same, and venation similar to *Ps. maura,* but the basal veins dislocated in the hind-wings (interstitial in *Ps. maura*); last joint of hind tarsi without spines beneath.

Length 12–15 mm.

Southern Pines, North Carolina.

Psammochares (*Allocyphonyx*) hesione n. sp.

♂. Black; clypeus truncate in front; antennæ short not very heavy; head rather broad, hairy; anterior ocellus its diameter from the smaller laterals, latter as near to eyes as to each other; vertex, from in front, barely rounded; pronotum arcuate behind; metanotum short, hairy, suddenly bent down behind; abdomen broad at base, depressed; legs heavily spinose, several spines on hind femora, even half way to the base, longer spur of hind tibia nearly three-fourths as long as metatarsus; no spines under last joint of hind tarsi; claws cleft. Wings much as in *Ps. maura;* the second submarginal cell very short, third nearly triangular, the second recurrent arising beyond the middle of the outer cell and running somewhat sinuously to the middle of the third submarginal cell; basal veins interstitial.

Length 15 mm.

From Douglas and Hamilton Counties, Kansas (Snow). Related to *Ps. maura,* but the legs are more heavily spinose, and the antennæ do not have such a strongly serrate appearance.

Cryptocheilus idoneus n. sp.

♀. Deep black, wings uniformly deep black or a little paler (not darker) at tips; clypeus margined, slightly, evenly emarginate, antennæ slender, but not near as long as head and thorax, third joint one and a half the length of first joint, scarcely one-half so thick; vertex slightly rounded; anterior ocellus fully its diameter from the nearly equal laterals, these very much nearer to each other than

to the eyes; pronotum slightly angulate behind; metanotum with a distinct median groove, not transversely striate; abdomen dull black, hairy near tip, not much depressed; legs slender, spiny, the hind tibia more slender than in *C. fortis* and with short but stout spines above, longer spur about two-fifths of the metatarsus, last tarsal joint with distinct spines beneath (not in *C. fortis*). Wings not very long, marginal cell rounded at tip (like *C. terminatus*); second submarginal plainly longer than broad, receiving the first recurrent at middle; third submarginal barely longer than broad, narrowed above; second recurrent arising much beyond middle of anal cell, curving outward to the middle of the third submarginal cell; basal veins dislocated in fore wings, nearly interstitial in the hind wings.

Length 12 mm.

From Southern Pines, N. C., July 14.

Pseudagenia antennalis n. sp.

♀. Iridescent blue, much like *Ps. cærulescens*, but differs from that species by the antennæ (except black basal joints) being yellowish-brown, and the anterior legs, except dorsal part of femora at base, are pale; the middle and hind tarsi are brown, and the tegulæ are also brown. In structure also similar to *Ps. cærulescens*, but the third joint of the antennæ is shorter than in that species, being only a little longer than the fourth joint; and the second discoidal cell of fore-wings is proportionately shorter and broader than in *Ps. cærulescens*. Of the same size.

From Fedor, Lee County, Texas, May 29, Birkmann Coll., through Prof. C. F. Baker.

Pseudagenia virginica n. sp.

♂. Black, with slight silvery pubescence, coxæ silvery, the spurs white, no white at tip of abdomen. Clypeus truncate, antennæ not very heavy, no line from antennæ to ocelli; anterior ocellus fully twice its diameter from the laterals, the latter a little closer to each other than to the eyes, vertex from in front slightly rounded, face rather long and narrow; hind margin of pronotum impressed, arcuate; metanotum short, rounded, transversely impressed near tip; abdomen slender, hardly petiolate, apical lower margin of first segment produced below; legs slender, longer spur of hind tibia nearly one-half as long as the metatarsus. Wings nearly uniformly smoky; the marginal cell rather long, acute; second submarginal one-half narrowed above, receiving the first recurrent vein before middle; third submarginal larger, one-half narrowed above, the second recurrent arises from beyond middle of apical cell, and runs obliquely to beyond middle of third submarginal cell.

Length 6 mm.

From Falls Church, Va., July 4, 1910.

ARGYNNIS CYBELE FABR. FORMA *BARTSCHI* F. NOV.

By William Reiff.[1]

Last spring while I was examining the collection of Lepidoptera belonging to Mr. Rudolf C. B. Bartsch of West Roxbury, Mass., we were talking on the always interesting theme of the variability of butterflies. Mr. Bartsch told me on this occasion that he possessed a very peculiar but much damaged Argynnis, which he had captured in West Roxbury, Mass., during the first week of July, 1907, together with two other specimens of the same kind. This specimen being in the best condition of all, he had kept but did not save the two other individuals as they were practically ruined. This specimen had the wings partially spread and on account of its injured condition Mr. Bartsch had placed it in a box by itself and laid it aside. He gladly fulfilled my very natural desire to see the interesting butterfly, and upon opening the box I was surprised to see a splendid *Argynnis*, which unfortunately had the wings seriously damaged and the body badly eaten by Dermestes. It was an *Argynnis* form which I had never seen before, neither in nature nor produced by artificial means. The specimen, a male, belongs without doubt to the *cybele* type. Against this identification the only argument would be the narrow, nearly faded light yellow band upon the under side of the hind wings, which is very broad in *cybele*. If we lay stress on this character, we might be led to suppose that we had a form before us belonging to the type *alcestis* Edwards. But this is impossible, since *alcestis* is an exclusively western subspecies. The eastern form *aphrodite* Fabr., which runs parallel with *alcestis* cannot be considered in this connection, since in *aphrodite* not only is the base of the underside of the fore wings always very red but the other colors have little conformity with those of *cybele*. There have not been seen, according to my knowledge, any specimens of *aphrodite* in West Roxbury and vicinity. Moreover, the place in which the aberration was taken is an isolated swampy meadow, almost entirely

1 Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 33.

surrounded by woods, and a flight to this place from localities far away is highly improbable.

The two photographs reproduced on the accompanying plate show very well the upper and under side of the specimen. It will be noticed that the fore wings do not have the breadth of normal *Argynnis* forms, while the hind wings show a more oval rounding than usual. All rows of spots and points beyond the base are confluent into more or less distinct bands and this is true both of the upper and under side of all the wings. It is this which gives the specimen its extraordinary appearance. The bands nearest the border are more distinct and complete than the inner bands, but except for the yellow on the upper side, which is somewhat lighter than usual, the colors are almost normal.

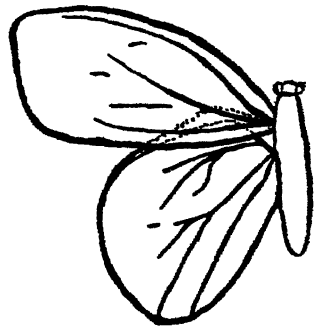


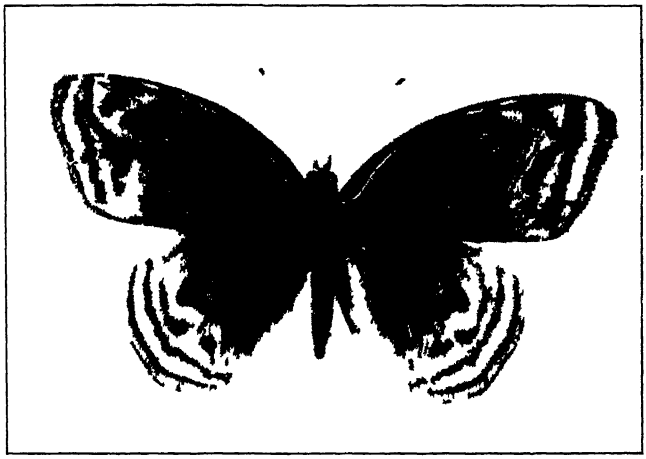
Fig. 1. *Argynnis cybele* Fabr., forma *bartschi* Reiff. Wing venation.

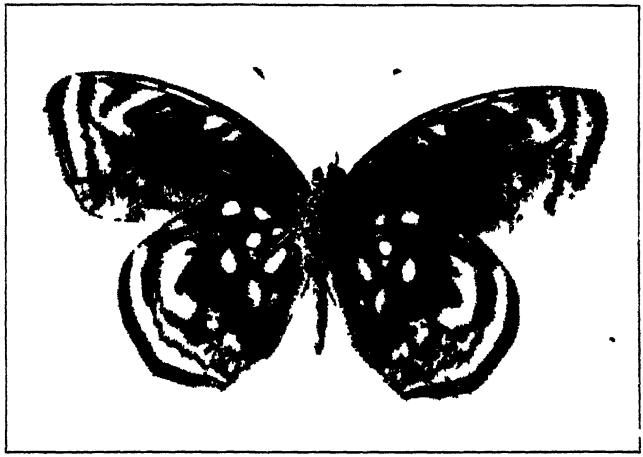
Now what is the cause of this peculiar aberration? At first I thought that I could consider it as a mutation, produced by some external influence, until I carefully examined the venation. Then I found that it was a "peroneurous aberration," *i. e.*, an aberration, which is produced by the absence of one or more veins or parts of veins. The expression "peroneurous aberration" was created by Professor Spengel of Giessen (Germany), from the Greek πηρός-aborted. A short time ago I described a "peroneurous aberration" of *Papilio machaon* in a paper which will appear in the next issue of the "Zeitschrift für wissenschaftliche Insekten Biologie." In the accompanying drawing I represent the venation of the *Argynnis*. The venation in the two

pairs of wings is similar. In comparing this drawing with the two photographs it will be seen that upon all those parts of the wings where the veins are present in a normal form, the markings are also normal. This is shown most clearly upon the base of the underside of the hind wings. All those parts of the wings, however, from which the venation is absent, are aberratively modified, the modification increasing as we pass towards the border of the wings. In a normal *cybele* wing, the black, yellow and silver markings are separated in more or less distinct isolated spots and points in consequence of the venation, while in the specimen under consideration all the rows of spots fuse to form complete bands on the parts where the venation is absent. The drawing and the photographs show that the form must have been produced in the manner just described. Moreover, the abnormal shape of the wings may also be traced to the partly missing venation, as the wings, of course, were arrested in their development on those parts which had no complete veins.

This examination also explains why Mr. Bartsch captured damaged specimens, since a butterfly, which lacks almost every vein beyond the middle portion of the wings, is inevitably liable to the danger of injuring its wings upon its first attempt to fly, because it exposes to the resistance of the air a large part of the surface of its wings which is devoid of every support. If the butterfly is struck by a gust of wind, or its wings occasionally strike against branches or leaves, the injury to the specimen will soon be complete. Our specimen, which was restored only after considerable careful work, had suffered most from a damage of the fore wings.

According to Mr. Bartsch's statements, the flight of this form differs considerably from the flight of the normal *Argynnis cybele* which occurs in large numbers in the same locality. He says it has a quick but more wavering flight, and that any flying specimen of the aberration can be readily noticed. The fact that in a single day in 1907 Mr. Bartsch caught three specimens of this form, induced me to try my luck during the past summer in the same locality. But on both days when I began to collect there the weather was so unfavorable that Lepidoptera would not fly. Mr. Bartsch was more fortunate, as he succeeded in capturing another specimen of the same form in the same locality this year,





REIFF- ARGYNNIS CYBELE FABR FORMA BARTSCHI REIFF

but it was a badly mangled individual. It would seem, therefore, that this form is not so very rare in this locality, although we should expect it to be very scarce on account of the peculiarity of its origin. Of the peroneurous *Papilio machaon* aberration, above mentioned, I secured two specimens from only 75 pupæ, which is also a proof that peroneurous aberrations can develop with comparative ease, though the conditions for such development are still unknown.

Mr. Bartsch very generously presented me with the interesting specimen of Argynnis and I have placed it in the collection of the Bussey Institution. In honor of the discoverer I would name this peroneurous aberration, *Argynnis cybele* Fabr. forma *Bartschi*. Its diagnosis would be the following:

Alarum venæ post mediam ad extremam partim immaturæ vel obsoletæ; propterea macularum seriebus omnibus in vittis confluentibus; ubivis venæ partim vel omnino obsoletæ sunt. Alæ contractæ, propterea aspectu aliquantum productæ.

Type: 1 ♂ in the collection of the Bussey Institution.

GEOMETRID NOTES.

A New Variety of Nyctobia.

By L. W. Swett.

Boston, Mass.

Nyctobia limitaria Walk.. **reiffi** var. nov.

Exp. 25 mm., palpi short, white typed body and thorax ash gray, antennæ black and white ringed. Fore wings ash gray, first a reddish brown basal band running outward below costa in a strong curve to median vein where it recurves to inner margin. Beyond this is a pale gray space 3 mm. wide where there is a broad chestnut brown band running from costa to inner margin, the inner edge of which is very irregular, the black linear discal spot is just visible, the extra discal edge of this band is bent outwards below costa at discal spot and inward towards inner margin, beyond this the wing is pale ash and two faint brown hair lines run brokenly to inner margin. Twin dots at ends of veins in the long ashen gray fringe. Hind wings light ash with a faint extra discal brown band, below which the wing is lighter. The fore wings beneath are light ashen with band showing through faintly the discal dot is black, and appears on hind wings also, which are same as fore

wings only there is a trace of two bands beyond discal spot. This variety can be told at a glance by the striking red-brown band across fore wings making it resemble slightly Xanthorlioe ferrugata.

This beautiful variety was given me by my kind friend, Mr. William Reiff, who took it in Forest Hills on the hemlock, together with two intermediate forms of the same variety.

Type: 1 ♀; April 5, 1910, Forest Hills, Mass.

ETHOLOGICAL NOTES ON *ELAPHRUS CICATRICOSUS* LEC. (COLEOPTERA)

By C. A. Frost.

A few words on the occurrence of this rare species of Carabidæ may enable some other collector to profit by my experience if they have plenty of time and patience.

My first specimen was taken at Monmouth, Me., in 1907 (about June 20) on the shore of a lake near the mouth of a small brook. I was sifting a pile of washed-up debris for Staphylinidæ when I noticed it running on the mud near where I had been standing. A careful search failed to discover any more at that time and each summer since, although I have even dammed up the brook in the hope of flooding out a specimen. The cause of its disappearance in this place is probably the removal of a heavy growth of alders that extended down to the edge of the water.

On June 23, 1910, after working this locality in vain, it occurred to me to explore a cold swamp about a mile further up the lake. This swamp, which is never dry, is traversed by a clear trout brook fed by springs and it is so heavily wooded that the sunshine penetrates into it hardly at all. In some places the mud is very deep and is covered more or less thickly with swamp grasses, dead limbs and logs.

I began operations here with a rusty pint dipper which I picked up at the spring, and almost the first dipperful of water brought out a specimen of Elaphrus from a slight hollow near the brook. It was *cicatricosus*, and for an hour or more I worked the old dipper–until the bottom fell out–without success. I now think

that the first specimen was driven out by stepping on a piece of stick that was partly buried in the mud. This method of throwing water is usually very successful in driving out specimens of Heterocerus, Staphylinidæ, Bembidium and other Carabidæ, but has not worked very well with any Elaphrus except *ruscarius*.

After the dipper gave out I began treading around all the likely looking places along the brook and before long drove two specimens out at once. These were the last seen although I continued the work until the approach of darkness put an end to the hunt which proved also to be the last one in this locality for the summer. The success of the three hours hard and careful work in this ideal haunt of *cicatricosus* shows that it is either very rare or the season was not right for it.

The first specimen taken in Massachusetts was at Sherborn on May 10, 1908, and was driven out by suddenly letting water from a flooded cranberry bog down the bed of a small brook. Two more specimens were taken here in the same way May 15, 1910. The bed of this brook is shaded by bushes and alders at the place where they were found and is wet and muddy until late summer when it entirely dries out. All efforts to find specimens here at other times have failed.

It may be of interest to note that five specimens of *Elaphrus clairvillei* Kirby were taken in the densely shaded bed of a brook which, although it attains a fairly large size in the spring months, was then dry and grown up to grass and weeds. This was on September 6, 1907. The specimens were disturbed by the feet of a party of surveyors and were discovered where the grass had been removed. All persuasive methods known to me failed to induce specimens to appear in this place until August 27, 1910, when I secured three of them by removing the grass and driving a trowel into the ground at short intervals. They would suddenly appear and remain motionless until an attempt was made to pick then up. I do not know whether they came out of the ground (which was filled with holes like those made by a woodcock), or were simply hiding in the grass, but I am rather inclined to accept the former alternative.

REVIEWS.

W. S. Blatchley. The Coleoptera or Beetles of Indiana. Bull. Indiana Dept. Geol. and Nat. Resources, No. 1.

To quote from the author, this work has been prepared "not for specialists . . . but for beginners," he modestly disclaiming an exhaustive treatment of the field covered and fully realizing that many other species will yet be recognized in his State.

A bulky volume of 1380 pages is devoted to the Coleoptera Genuina, the treatment of the Rhynchophora being reserved for future accomplishment.

Analytical keys to genera and species and brief descriptions of Indiana species known are given and such other species as have been taken in the adjoining regions are included in the keys and noticed in the text. To save space no attempt is made to print matters relating to synonymy, but the place of original description of every species is noted and quite full references are given to the various memoirs that have appeared treating of different groups. Of these latter the author has made free use so that his volume fairly reflects the present condition of the science in this country. Numerous figures, copied and original, enliven the pages and add much interest. At the end of the volume is a glossary of terms used and an index to families and genera.

Mr. A. B. Wolcott has contributed the text of the Cleridæ with fourteen original cuts. In the course of the volume 80 new species are described and one new genus, *Blanchardia* allied to *Omethes*. This generic term and others of similar derivation in honor of the French entomologist have been so often used that it will be necessary to provide another name for the genus.

Besides the usefulness of such a work to the less advanced student there is much to interest the most experienced; the many original observations, the new characters used to define species and as a faunal list; and to us it seems that the "Bulletin No. 1 of the Indiana Department of Geology and Natural Resources" is quite worth the while for the great State of Indiana to assume the publication.

FREDERICK BLANCHARD.

PSYCHE.

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